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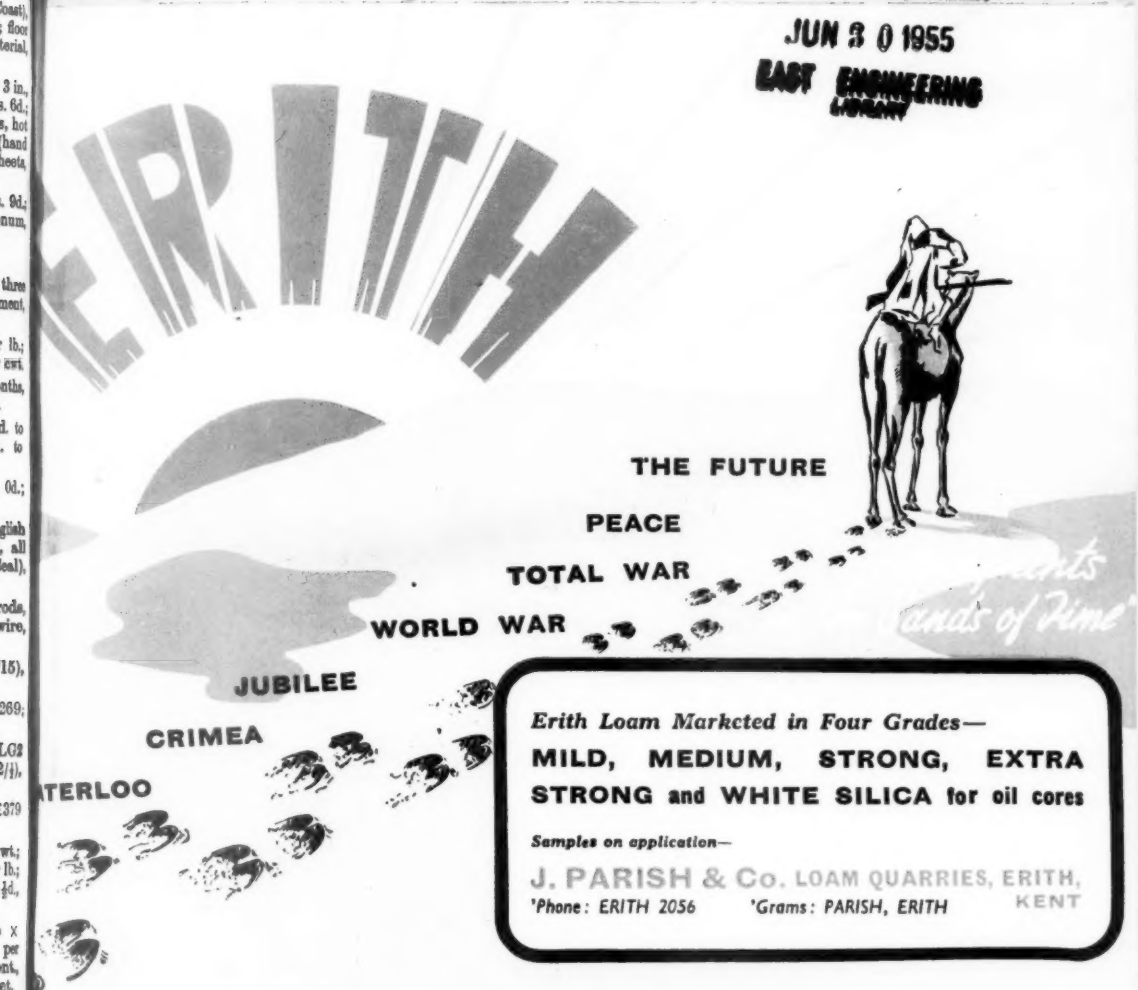

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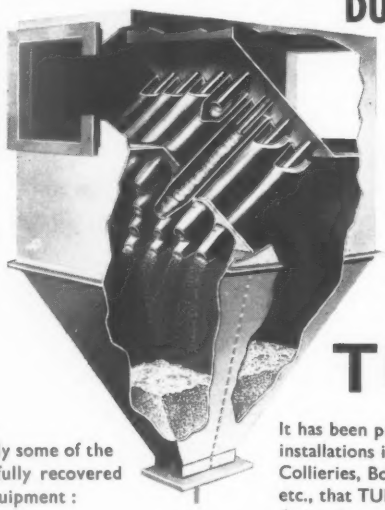

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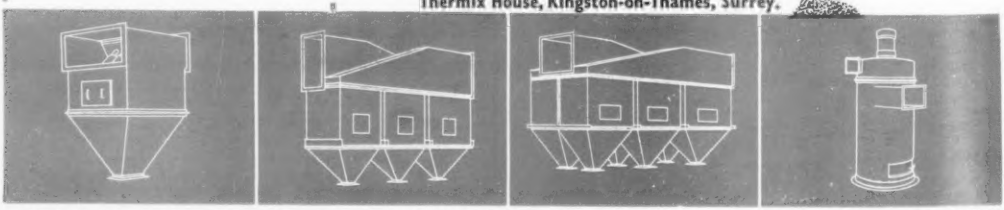

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Plastics and the Foundry

During a visit to the Plastics Exhibition at Olympia we took advantage of the occasion to ascertain what the makers of the plastic resins thought about our industry. The exhibition includes quite impressive machines for extruding, pressing and casting plastics, as well as the final article—often beautifully coloured and invariably finely finished—ranging from motor-car bodies, imitation metal products, down to toys and fabrics. Despite its comprehensive nature, quite a few of the firms supplying the foundry industry with resins were not represented. However, perhaps this was on account of space limitation, for we were told a larger hall is to be used on the next occasion in 1957.

First, we tried to get an approximation of the importance of the foundry industry as a customer for plastics. In one case, no less than 20 per cent. of the firm's output was reported as being absorbed either for mould- or core-making. In other cases, the proportion was as low as 2 per cent. To our query as to whether this market was expanding, the concensus of opinion was that after a rapid growth the demand was slowing. Real efforts were being made to extend the overseas market for foundry resins and at the moment one technical representative is working in France and a second in Scandinavia. On the technical side, it was apparent that the correct view to take of foundry plastics is much the same as that accorded to pig-iron, where the requirements vary with the casting to be made. There is no one universal resin which is equally well suited for use when making steel, iron and light-alloy castings or indeed gives of its best with every type of shell or core-making machine on the market. The makers of these resins believe that the most important problem the foundry-equipment trade has to solve is the joining of the two half-moulds together. There are some good systems available, but there is still room for improvement.

We found the technicians of the plastics trade really knowledgeable on foundry matters. They were conscious of the fact that their co-operation had made the buyers of castings become even more insistent on surface finish and close dimensional tolerances. They were aware that the best—but only the best—of the repetition founders could achieve results, using conventional methods, in every way comparable with those made by shell moulding, and that the market they had entered was competitive. As an industry, plastics manufacturers are enthusiastic believers in research and development and at least one operates an experimental foundry. In our industry, a new market has been found for their products and it is their firm belief that through intelligent co-operation and research it can be developed and expanded.

Institute Golf

The annual meeting of the Institute of British Foundrymen Golfing Society will be held at Woodhall Spa on September 24 and 25. Non-playing IBF members and their wives are particularly welcome at this event. All will stay at the Golf Hotel in one party. This hotel offers first-class accommodation and is recommended with confidence. The cost is £3 10s. 0d. per head from Friday night (including dinner) to Sunday (including luncheon). Separate days (including all meals and afternoon tea) £1 5s. 0d. per head. The charges are subject to a 10 per cent. surcharge for gratuities.

The standard scratch score is 74 and handicaps are limited to 24. A course allowance will be made—therefore competitors are asked to provide a score card of the course on which they are handicapped.

Saturday Morning, September 24

This will be a medal round of 18 holes. Couples will be arranged on a similar handicap basis. The lowest net score returned wins the IBF Handicap Challenge Cup (to be held for one year); (present holder, Mr. A. T. Johnston), the lowest grosss core returned wins the IBF Scratch Challenge Cup to be held for one year (present holder, Mr. P. B. Higgins). The two winners will also be presented with the usual IBF tankard prizes kindly presented by the president of the Institute (Mr. J. Bell). No competitor can win more than one prize in the morning. There will be an optional 5s. sweepstake on the handicap event only. Ties, if any, will be decided on the last nine holes, or, if necessary, on the last 12 or 15 holes, and sweepstakes will be divided. There is also a Veterans Cup open to those aged 55 and over. Concurrently with this competition, the Coronation Shield will be competed for by teams of three from each branch of the Institute represented (to be nominated by 10 p.m. on Friday, September 23). The branch team with the lowest net aggregate wins and holds the Shield for one year (present holders—West Riding of Yorkshire first team).

Saturday afternoon.

Two-ball foursomes will be organized against bogey under ¾ of combined handicaps for a 5s. per head entrance fee and sweepstake (two-thirds to winners, one-third to the runners-up). Two Lincoln Imps go to the winners kindly presented by the Lincolnshire branch. Partners will be drawn on the "sheep and goats" basis.

Sunday, September 25.

Four-ball foursomes against bogey will be held (three-quarter handicaps). Partners will be by personal arrangement for a prize of one dozen golf balls, kindly presented by Mr. R. C. Shepherd—sweepstake arrangements the same as for Saturday afternoon.

Ladies' Competition.

This will be for the Coronation Rose Bowl—highest Stableford score wins and hold the award for one year (present holder—Mrs. W. N. Cook). Entrance fee and sweepstake 5s. per head.

Green fees of 7s. 6d. per day are to be paid to the IBF Golfing Secretary, Mr. P. G. Pennington—one round 5s. Starting times are (promptly), mornings 8.30 a.m.; Saturday afternoon 2 p.m. The time sheet for Saturday morning and afternoon will be posted to all competitors a few days before the meeting.

All entries should be sent to the IBF golfing secretary (Mr. P. G. Pennington), c/o G. Oxley & Sons Limited, Vulcan Foundry, Sheffield, 4 (not later than August 24) on a form which he can supply.

Correspondence

UNIFORM QUOTATIONS

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Your Editorial of June 2 suggested that "proper costing" and not monopoly was the reason for quotations which "vary little." In my experience of the aluminium foundry industry, I can assure you that out of thousands of quotations which we have sent out, only in very few instances have any of our competitors quoted exactly the same figure. In almost every case there has been a 5 to 25 per cent. difference in price. This is due to dissimilar estimates of weights and of production times. We recently sent a set of identical prints to two independent drawing-offices for weight checking of our own figures, and there were substantial variations in the results. Also, overheads and profit margins are seldom exactly the same.

This is a healthy state of affairs, where keen competition keeps the charges so low as to cause frequent complaints from the less-efficient foundries. On the other hand, restrictive practices, resulting in several tenders of thousands of pounds being identical to the last penny cannot in any circumstances be attributed to "intelligent costing."

What is the point of sending out enquiries and tenders, if the results are predetermined? Purchasing officers in most leading engineering firms know full well where monopolies exist and which firms belong to price-fixing associations.—Yours, etc.,

LEON GAMSA, B.Sc. (Eng.).

Slough Metals Limited,
Oxford Avenue Trading Estate,
Slough.

June 3, 1955.

[In the leading article referred to, the Editor was neither referring to jobbing work, nor did he associate faulty estimation of weight as entering into his estimate of "intelligent costing."]

Spanish Iron and Steel Institute

The Instituto del Hierro y del Acero (the Spanish iron and steel institute) is holding its third general meeting in Barcelona from June 20 to July 2. One session—on Wednesday, June 21, is to be devoted to foundry practice. Five papers are to be presented covering moulding sands, cement moulding, making a drum casting and shell-moulding. At a later session, Dr. V. Kondic is the joint author with Mr. J. M. N. Alvargonzalez of a paper on the "Viscosity of Metals and Alloys." In the afternoon of June 27 there is a visit to the local works of Babcock & Wilcox, Limited. Full details of the conference, works visits and tours can be had by writing to the Institute at Villanueva, 13, Madrid.

THE ALUMINIUM INDUSTRY COUNCIL, the headquarters of which are in Birmingham, has just completed its first five years work. The Council, established in June, 1950, was set up to continue and expand the liaison work carried out earlier, experimentally, by the Aluminium Industry Advisory Committee. The present chairman of the Council is Dr. Horace W. Clarke, the recently-elected president of the Aluminium Development Association. The Council co-operates very closely with the ADA in its representation of the collective interests of those engaged in the reduction, smelting, casting, forging and flaking of aluminium and its alloys within the United Kingdom, both in the manufacturing and commercial spheres.

Aspects of Steelfoundry Practice*

By H. Hart

From many a designer's point of view a steel casting is an inferior material in comparison to a steel forging, the reason being the occurrence of unobserved flaws and unsoundness, the causes of which are numerous. Regardless of that opinion, however, standards of inspection on steel castings have improved considerably in recent years, unobserved flaws are exposed by X-ray and gamma ray. The demands of precision and soundness have increased with reduced sectional thicknesses and minimum machining allowances. The Paper details a number of methods which have been adopted in the steelfoundry to meet this increased stringency of requirements.

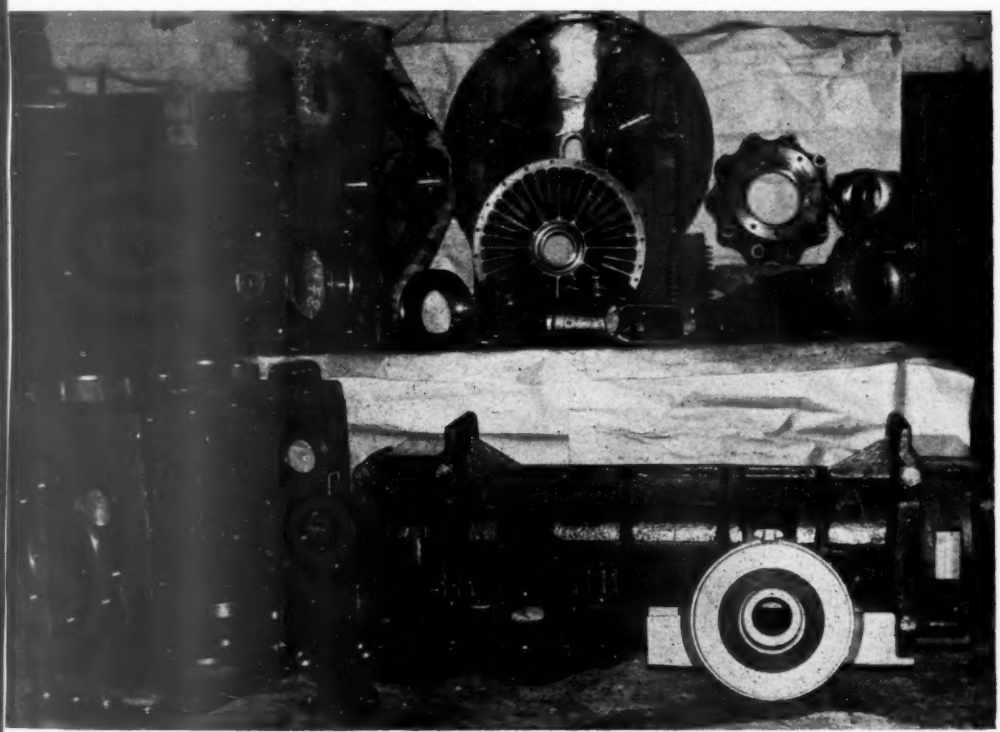
The firm with which the Author is associated, makes a large variety of light steel castings for rolling stock, for withstanding high pressure, and components for motor vehicles (Fig. 1). The last, in particular, are of thin section and intricate design. These demand high standards of precision and soundness in manufacture owing to the great working stresses involved. It was found that a small degree of variation in procedure in making these castings could lead to negative results, and, in consequence, it was appreciated that absolute standardization of manufacture was necessary to each particular item.

* Paper read before the Scottish branch of the Institute of British Foundrymen. The Author is on the staff of the National Steel Foundry (1914) Limited.

Methods Department

A methods department has been installed, where careful records of unsuccessful as well as successful techniques can be collected for future reference. A methods card is issued with every pattern to the foundry, with full instructions and details as to the method of manufacture, and it is essential that the foundry personnel shall carry out these stipulations, owing to the low degree of variation permitted in

FIG. 1.—*Group of automobile castings made by the National Steel Foundry* (1914) *Limited.*



Aspects of Steelfoundry Practice

making sound castings. This system has other advantages in the fact that it leaves the foreman more time to organize the working of his shop, supervise and ensure that moulds and cores of good quality are being produced. Too often in the past, such duties have kept the foreman fully occupied, and the time left to him to study in what manner incoming patterns were to be made was all too short, logical reasoning was non-existent, and only a few chalk marks (without dimensions) were made on the pattern. It has been known for a foreman

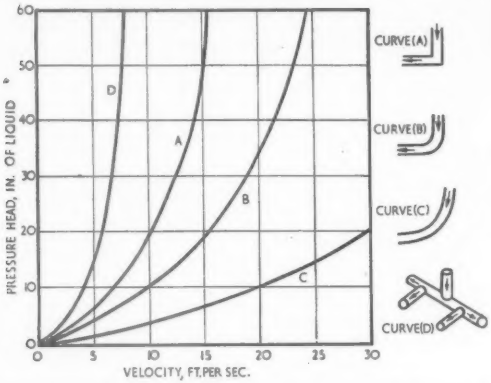


FIG. 2.—*Changes of gate direction and their effect on velocity of running (after, Lips).*

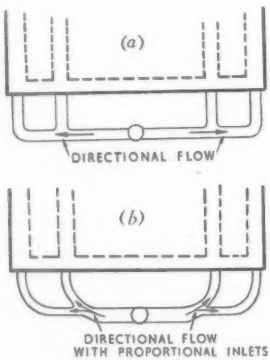


FIG. 3.—*Two designs of multiple joint-line runners.*

to indicate by a chalked cross where risers were required. To ensure progress, the future demands modern thinking as well as modern plant and strict control of all details must be exercised throughout the various stages of manufacture.

It is essential to make sound castings regularly, and obtain the maximum output of good castings from a given amount of raw material. Research continues, technical developments have been passed on and utilized where practicable, but individuality

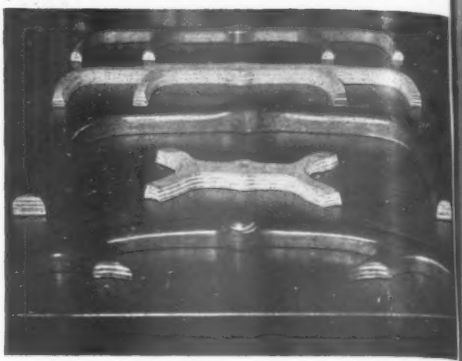


FIG. 4.—*Runners made from plywood.*

still plays an important part within the industry, in the adoption of the results of experience and experiments on the shop floor, then choosing techniques which are practicable, economical and suitable to the type of castings being produced.

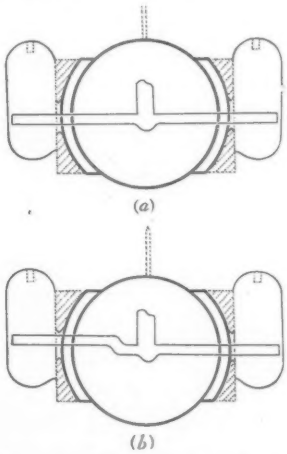


FIG. 5.—*Two applications of the atmospheric knock-off side-runner.*

Gating

Various aspects in any design have to be considered when determining in what manner, and where, a casting shall be run, to avoid the various implications usually associated with faulty running systems. Equalized cooling to minimize stresses has also to be considered, yet other designs are suited to having a pronounced temperature gradient. There are some basic principles in the runner system itself, however—an easy uninterrupted flow with inlets and downgate in proportion, is advantageous, and it is necessary to be of firm construction. These, when incorporated, are the first simple steps in producing sound castings.

Fig. 2, a diagram prepared by Lips, shows the variation of the velocity of metal flowing under pressure through various designs of ingate. Curves (*a*) (*b*) and (*c*) show the loss of velocity that occurs when molten metal undergoes a change in direction of 90 deg. Curve (*d*) shows what the losses may be when there are two sudden changes in direction. Fig. 3 (*a*) shows the common-joint-line, multiple-inlet runner. Downgate, runner-bar and inlets are not proportional. The metal has its directional flow before it reaches the inside inlets and bypasses them, so that the bulk of the metal enters the mould through the end inlets. There is also a sudden alteration in direction, resulting in a pile-up action of the metal at the extreme angles. Runner (*b*) is similar, being designed to facilitate an easy passage for the metal, by avoidance of angles; inlets are proportional, thus ensuring an even flow through all four. The possible reason why runner (*a*), with all its shortcomings, is popular, is that it is easily made in the patternshop and in the foundry. A runner pattern of this design brings the grain of the wood in a way that it is easily broken off at the radii, consequently repairs and replacements are continually being required. To overcome this

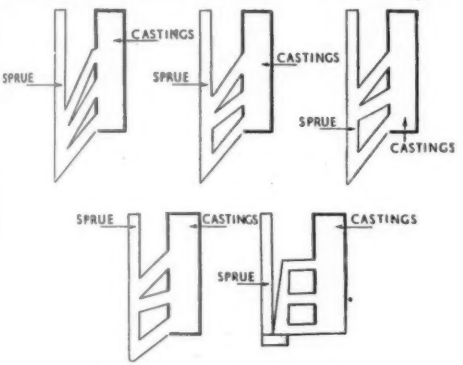


FIG. 6.—*Designs of step gates.*

problem, all runners of this type are now made of plywood.

Fig. 4 shows runners in various stages of manufacture. They are of the type which do not fracture or break easily even with a fair amount of abuse. When a runner of this type is made, it is more or less permanent. Fig. 5 (*a*) shows a cylindrical-type casting run through two atmospheric, knock-off side-heads. With this method of running, the metal enters the mould simultaneously from opposite directions, and is in constant collision until the section thickness from mould to core has been filled up. This "clash" action of the metal leads to turbulence, intermingling and trapping of oxides and can lead to local porosity on the underside of the core. Also, if there has been any dross carried in, it will probably lodge at this spot. Sketch (*b*) is of a simple joint-line step-gate, which is very effective on this type of casting. One half of the runner is in the drag portion of the mould,

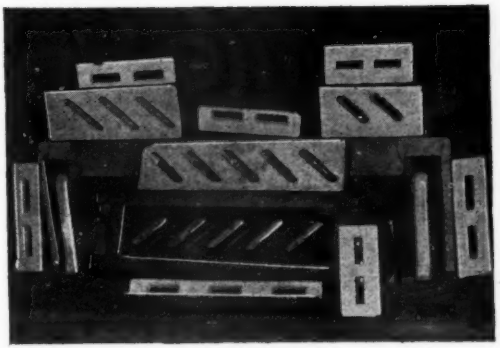


FIG. 7.—*Types of runner-cores and prints for them with the up-runners in position.*

while the other half which goes in the opposite direction is placed in the top-half. The function of this runner is that the metal enters the mould initially on one side only, resulting in a quiet flow in one direction with a gradual build up, then a

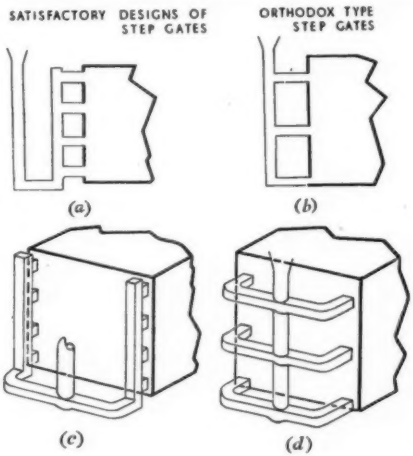


FIG. 8.—*Satisfactory* (*a*) *and* (*c*) *and orthodox* (*b*) *and* (*d*) *step-gating systems.*

flow-through action under the core until the metal is in line with the secondary runner, which then starts to operate. From this point onwards, the mould is filled from the two inlets. The disadvantages of runner (*a*) and its collision consequences no longer prevail. Local porosity, occasionally evident when conditions of turbulence and intermingling occur, is now no longer developed; this as a result of the use of the joint-line step-gate and the flow-through action in the bottom half of the mould. The ability of this type of runner to prevent porosity on this particular design of casting has been substantiated in machine-shop reports.

Aspects of Steelfoundry Practice

It is customary to use bottom gating to avoid erosion of the mould and its resultant consequences, when the joint-line gate involves a drop for the metal to fill the drag portion of the mould. With this method of running, however, a local hot-spot is usually created at the runner inlet. Furthermore a temperature gradient is set up throughout the casting, with the hottest metal at the bottom of the mould. This is the opposite of the desired requirements. Such an adverse temperature gradient can be overcome by the proper application of step-gating.

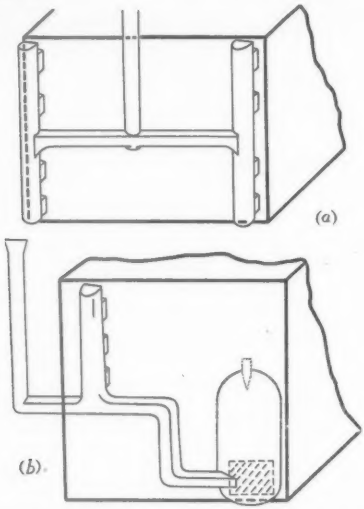


FIG. 9.—*Machine-moulding applications of the step-gate system.*

Step-gates

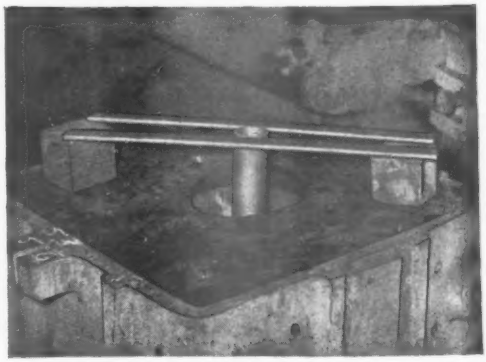
Step-gates are made in numerous forms and designs of which some are effective and some not. A desired property of a step-gate is to bring hot metal into the upper parts of a mould during casting. It is essential, therefore, in order to obtain full value, as the metal rises in the mould and each inlet in turn takes over, that the lower inlets in their turn should become totally inactive. This also allows solidification of the metal to proceed from the top active inlet downwards, by the elimination of metal movement in the lower portion of the mould. Simple systems of step-gating, where several horizontal inlets lead off a vertical downrunner are usually inefficient. The downward thrust from the ladle will continue to push a fair volume of metal into the bottom inlet, even after a secondary inlet is in operation. The position arises whereby at least two inlets function to admit variable volumes at the same time. Fig. 6 shows several designs of step-gates, developed by Pellini[2] and colleagues, that give the desired effect of progressive filling up of the mould, but they are not found very practicable in application because they lack simplicity. On the result of a number of tests carried out at the Author's firm, several designs of step-gates have been devised, with the keynote of simplicity with efficiency. Inlets are formed by a complete core, which eliminates the necessity of extra joints, cake or slab cores being required in the formation of each inlet during the ramming up process of the mould. From the bottom of the downgate, or runner-bar, the metal flows in an upward direction before it enters the inlets. On reaching the level of the secondary inlet, the least line of resistance is taken, and the bottom inlet ceases to function. This position arises as each of the higher inlets come into operation.

FIG. 10.—*Step gate for a cylinder casting.*

Fig. 7 shows a corebox, several types of runner cores, and the prints with the uprunners in position. For flat surfaces, a standard corebox is used, with variable and adjustable inlets, which can be made to any suitable length by stop-off pieces. Fig. 8 illustrates the system of running, and design (*a*) is now substituted for the simpler but inefficient runner (*b*) and (*c*) is now substituted for the multiple runner (*d*).

Fig. 9 (*a*) shows a design suitable for machine moulding, with the runner-bar on the joint-line, connecting the twin steps. There is a short drop for the metal to the inlets below joint level; the top half is then filled up by the reverse action of an upward flow. Sketch (*b*) is a combination of running through a side-head initially, then latterly

FIG. 11.—*Novel method of running a casting—using a steel pipe.*



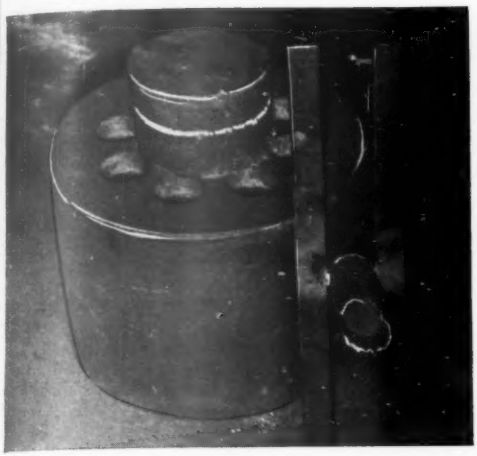


FIG. 12.—*The remains of the steel tube and the casting for which it was used.*

with a step-runner. Fig. 10 shows another side-head/step-gate combination that was used on a cylinder casting. If the inlets had been in a perpendicular line there was every possibility of hot-tear formation being created lengthwise down the casting, close to the inlets. The inlets in this instance were tangential and the purpose of this was for the inlets to act as brackets, as well as being a means of conveying metal into the mould.

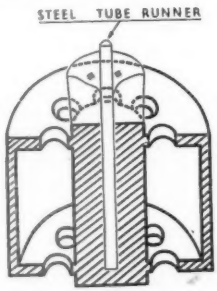


FIG. 13.—*Sectional view of the casting (Fig* 12) *showing the position of the steel tube.*

Unusual Types

Fig. 11 shows a most unusual runner—a 2-in. dia. steel pipe, fastened to a cross-member (the latter has been raised for the purpose of viewing). When in the casting position, the cross-member is flat on the box part, and weighted down and then a runner-bush is placed on the steel pipe. This type of runner is constructed for castings that are suitable to be run down the centre, so as to develop a temperature gradient from the outside of the casting towards the centre. Occasions arise where castings have a solid centre and the ideal method of pouring would be down the centre riser. This, however, would involve a drop for the metal, which would create excessive splashing and erosion of

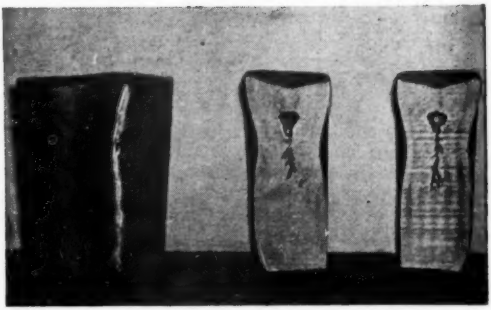


FIG. 14.—*Two risers (one of them sectioned) unassisted by atmospheric pressure.*

mould and cores in the vicinity of the metal stream. By using a steel-tube runner and placing it approximately 2-in. from the bottom of the mould, this problem of splashing is overcome. The temperature of the molten metal as it rises in the mould soon melts the steel tube.

By applying exothermic powder to the top of the riser after casting, either as a means towards assisting feeding as was done in the example shown, or in small proportion to raise surface temperature of the riser, the remainder of the tube, along with the cross-member, can be lifted out. Fig. 12 shows the casting, what remains of the runner and also an

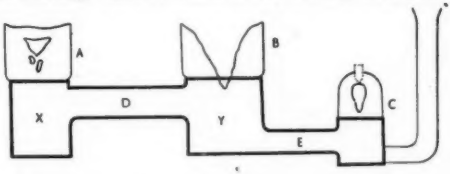


FIG. 15.—*Examples of unbalanced feeding.*

indication where the riser is cut off; Fig. 13 shows a section of the casting and the position of the steel-tube runner.

These various gating techniques have been successfully applied in regular practice in the Author's foundry and have proved to be more beneficial than orthodox gating methods in obtaining a particular desired function.

Atmospheric Pressure

Fig. 14 shows two risers (one sectioned) that did not have the assistance of atmospheric pressure. After casting, the risers rapidly formed a solid skin and sealed off the atmosphere from the liquid interior, which then fed the casting by gravity only. With liquid contraction creating a vacuum in the riser, the atmospheric pressure—of 14.7 lb. per sq. in.—pushed in the riser walls, until they developed in strength and were then capable of resisting this pressure, then no further caving took place. Lack of feeding from this point onwards created riser cavities. This example illustrates the power of atmospheric pressure which is an important feature of feeding practice, when understood and utilized to advantage.

Aspects of Steelfoundry Practice

Fig. 15 illustrates an example of unbalanced feeding. Riser (*a*) freezes over, leaving riser (*b*) open to atmosphere. Riser (*b*) will then feed all the casting including risers (*a*) and (*c*). Although (*c*) is open to atmosphere by reason of the incorporation of an atmospheric core, riser (*b*) has the added advantage of ferro-static pressure and will continue to feed riser (*c*) until balance is obtained by a solidification in section (*e*); then riser (*c*) will start to operate. Riser (*b*), however, will continue to feed the remainder of the casting, including riser (*a*), until solidification takes place in section (*d*); then riser (*a*) will feed section *x* by gravity. The point arises that with riser (*b*) doing all the initial feeding, the bulk of the feed metal has gone and the demands of section *y* may not be satisfied. To maintain balance, it is essential to ensure that top risers remain open to atpmosphere, and where lower blind-heads have been adopted and connected by a fair proportional section thickness of metal, it is advisable to hasten solidification of that section by chilling, whereupon balanced feeding will operate.

(*To be continued*)

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Lubatti Process for Smelting Iron-ore Fines

A development in using electric furnaces for solving the problem of processing iron-ore fines is being investigated in conjunction with the Lubatti electric furnace in Italy.* The process is carried out in a furnace consisting essentially of a flat hearth with a refractory lining and one tap-hole each for metal and slag. The top of the hearth is entirely open, the furnace itself having no roof. Further, it requires neither tilting mechanism as in the case of conventional arc furnaces nor any rotating mechanism as is used in various other methods of ore reduction. The greater part of the furnace space is taken up by molten slag, which is heated by means of ball-shaped graphite electrodes dipping into the melt. These electrodes are fitted to water-cooled electrode holders at the sides of the furnace, thus permitting free movement both horizontally and vertically.

The burden, consisting of fine ore, is fed continuously by a conveyor on to the surface of the liquid slag in such a way that a layer of 6 to 8 in. thick floats on the surface of the slag. The ore is reduced within this layer and the energy required for the reduction process is taken from the slag-bath, which has a temperature between 1,500 and 1,600 deg. C. The carbon-dioxide gas generated during the process escapes through the layer of the burden which, owing to the fact that it is comparatively thin, offers no appreciable resistance to the passage of the gas. Since the particles of the burden are small and thus have a large surface area in relation to their weight, the carbon-monoxide is utilized for pre-reduction within the layer of the burden.

The gas escaping at the surface contains on the average twice as much carbon-dioxide as carbon-monoxide. It is claimed, therefore, that the energy contained in the coal is considerably better utilized than in the case of either the conventional blast-furnace or in a low-shaft furnace. The gas escaping burns away on the surface of the burden in the form of small flames spread over the whole area of the furnace top. It would appear to be possible to recover these gases, though this has not yet been attempted. In the contact zone between burden and slag the reduced metal is melted to form small globules, which then descend through the slag layer and collect in the furnace bottom.

At present, four Lubatti furnaces which are in production, make pig-iron from pyrites and various iron-rich dusty residues. In a furnace of 1,500 kva. rating, fitted with six electrodes, a daily output of 10 tons is being achieved, the iron having the following percentage composition: C, 2; Si, 1.5; Mn, 1; P, 0.11; S, 0.23. Power consumption is 3,225 kwh./ton of pig-iron produced, the make-up of the burden to produce one ton of pig-iron being as follows in kilogrammes:—Pyrites ashes, 1,500; iron sand, 8; manganese ore, 64; mill scale, 209; limestone, 420; sand, 29; china clay, 80; loam, 2; bauxite, 11. The carbon required for reduction is added in the form of anthracite and coke fines. Slag amounting to 763 kg./ton of iron produced results from this burden. Despite the high sulphur content (1.9 per cent.) a 90 per cent. desulphurization of the burden is achieved.

Advantages and Problems

The main advantages claimed from the Lubatti process are the following:—(1) Fine ores and fine coals can be used. A wide variety of raw materials such as ore dust, pyrites ashes, and "rotschlamm" from aluminium production, can all be used conveniently. The reducing agent can be any type of coal, coke or brown-coal dust. It is claimed that low-carbon irons can be produced. Pre-reduction of the burden by the utilization of carbon-monoxide is possible. The furnace has a good thermal efficiency, owing to the insulating effect of the burden which is continuously maintained above the level of the molten slag. Consumption of electrodes is very low compared to electrode consumption in conventional arc furnaces. The capital cost of the furnace itself is low; also it can be housed in a simple building and needs no complicated and expensive ore-preparation plant.

The only major difficulty which has so far presented itself is the problem of finding a durable refractory lining for the hearth, although carbon-rammed linings are satisfactory where they come into contact with the slag, the carbon of this type of lining is picked up by the metal and therefore slowly consumed. On the other hand, magnesite bricks are suitable for the furnace-bottom but are unsuitable for the side walls as they are attacked by the slag.

* From an article on "Recent Advances in Steel Technology" prepared by the Industry Division, Economic Commission for Europe and published by the European office of the United Nations, Geneva (Price 3s. 9d.).

Notes from the Branches

Lancashire

At the annual general meeting of the Lancashire branch of the Institute of British Foundrymen, Mr. F. W. Nield, the branch secretary, introducing his report for the year under review, asked members to do everything possible to encourage apprentices to join the Institute. Twenty-four associates had joined during the year.

The report opened with a tribute to Mr. E. Jackson, the retiring president, for the meticulous attention he had given to the affairs of the branch.

Works Visits

The branch had had the opportunity of visiting three works during the session. In September, 50 members visited the works of Newton Chambers, Thorncliffe, near Sheffield, seeing the light-mechanized and heavy-jobbing foundries, machine-shops and training centre and also a film of the activities of the company. The second work's visit was to the British Insulated Callender's Cables Limited, Prescot, where the party was most impressed by the way the company handled the melting and pouring in 800 tons per day of copper ingots. The last work's visit took place in March when a small party visited the works of the Enfield Rolling Mills (Aluminium) Limited, Bradford. The party was undoubtedly impressed with the efficient way that this company dealt with the recovery, melting and pouring of aluminium alloys. The branch was much indebted to the directors of these three companies who had allowed members to visit their works and for their kind hospitality.

Lectures

During the session there had been six lectures, three dealing with the non-ferrous side of founding, one on steelfounding, one on ironfounding and one covering mechanical handling. Of the three non-ferrous papers, Dr. E. C. Ellwood, of the Tin Research Association, presented a paper and showed an interesting film on the "Semi Continuous Casting of Bronze." Mr. R. Mercer, of Enfield Rolling Mills Limited, presented a paper which dealt very thoroughly with aluminium casting alloys, and Mr. F. Hudson, of the Mond Nickel Company, London, had accompanied his paper, "Melt-quality Control in Non-ferrous Foundries," with an interesting film.

It was not often the branch had papers' or films on steelfounding but it was impossible to overpraise the paper presented by Mr. Taylor, of the English Steel Corporation, Sheffield, entitled "Production of Heavy Steel Castings." The magnificent colour film, which was also shown, well portrayed the outstanding achievement of Mr. Taylor's company in producing such a large casting—a tribute also to the high standard of British craftsmanship.

The paper on ironfounding was presented by those two well-known members of the branch, Mr. H. Haynes and Mr. C. R. van der Ben, who always present excellent papers and are always willing to pass on to other members the benefit of their experience. The paper dealing with mechanical handling was presented in a very interesting and concise manner by Mr. C. M. G. Wallwork, of Henry Wallwork & Company, Manchester. This type of paper was not often heard by members, but all who listened to it would certainly have benefited from Mr. Wallwork's interesting ideas.

Social Side

The social side of any branch was an essential activity and in this direction Lancashire had played its part. The social secretary, Mr. A. Kirkham, and his committee, were due for congratulations for the splendid arrangements which helped to make the January annual dinner and dance, held at the Grand Hotel, Manchester, a most successful affair. Among those present were Mr. John Bell, the president of the Institute, and the vice-presidents, Dr. A. B. Everest and Mr. H. J. V. Williams, Mr. George Lambert, secretary of the Institute, and Mr. D. Pratt, assistant secretary, Mr. G. Mundel, past-president of the Association of Bronze and Brass Founders, Mr. Keppal Massey, Mr. Leslie Mortlock, Mr. E. Longden, Dr. Dadswell, and Mr. Bernard Gale, president of the Burnley section.

The John Wilkinson short paper competition this year did not appear to have been as popular and there had been a definite decline in the number of papers submitted. It was the feeling of the branch Council, who put so much hard work into organizing this competition, that more encouragement to take part in this competition should be given to young apprentices by individual members of the branch.

Burnley Section

The Burnley section had had a very good session under the presidency of Mr. Bernard Gale. It was clear there had been a good programme of lectures and an ample variety of subjects. One paper in particular was of very high standard and the Lancashire branch committee had put the author's name forward for a recommendation for a Diploma.

During the past session, one member, 12 associate members, and 24 associates had been admitted. The financial side of the branch was in the hands of Mr. H. Booth, to whom sincere thanks were due.

Concluding, the secretary thanked Mr. George Lambert, who although a very busy man during the past year, had always spared time to offer advice whenever requested.

After votes of thanks had been accorded to Mr. Nield for his untiring efforts, and to the retiring officers, the retiring president, Mr. E. Jackson, expressed his thanks for all the help that he had been given.

The new officers elected were, as *president*, Mr. A. Kirkham; as *vice-presidents*, Mr. W. Spenceley, and Mr. E. Beech; *branch Council* members for three years were: Mr. B. Gale, Mr. A. Smethurst and Mr. C. Swinglehurst; as *branch representatives to general Council* (for one year), Mr. H. Haynes, Mr. D. Fleming and Mr. C. R. van der Ben; and *branch representative to Technical Council*, Mr. C. R. van der Ben (deputy, Mr. W. Spenceley). Mr. D. Cameron and Mr. A. Smethurst were re-elected *auditors*; Mr. H. Booth re-elected *hon. treasurer*; and Mr. F. W. Nield, re-elected *hon. secretary*.

The John Wilkinson awards were then presented to Mr. Norman Cunliffe, of William Woodcock & Company, Limited, Phoenix Foundry, St. Helens, first; Mr. Richard Spencer, second; and Mr. Donald Scott-Price (also of the Phoenix Foundry of William Woodcock & Company, Limited), third. The retiring president, Mr. Jackson, making the award of the medal and cheque to the winner, and cheques to the second and third, expressed the appreciation of the branch to Mr. Stanley Brooks who had done so much hard work in organizing the competition.

Afterwards, a "Brains Trust" was held, under the chairmanship of the guest question master, Mr. Frank Neath. Members of the panel were Mr. E. Beech, Mr. N. Cook, Mr. R. Masterton, and Mr. A. Wildes.

Institution of Metallurgists

New Diploma in Metallurgy?

Following a members' luncheon on May 25, the annual general meeting of the Institution of Metallurgists was held at the Park Lane Hotel, London, when the new president, Prof. F. C. Thompson (Manchester University) was inducted. New officers now elected include:—*Vice-presidents:* G. L. Bailey, C.B.E. (hon. treasurer and founder member, BNFMRA), and Dr. I. Jenkins (General Electric Company, Limited); *honorary treasurer:* Dr. E. G. West (Aluminium Development Association); *Members of Council (representing Fellows):* E. A. Bolton (Imperial Chemical Industries, Limited), T. R. Middleton (English Steel Corporation, Limited) and F. Cousans (Hadfields, Limited); *(representing Associates):* J. Grainger (Ministry of Supply, D.At.En.(P)).

Presidential Address

Prof. Thompson based the subject of his presidential address on the value of the metallurgist in industry, his technical knowledge and the qualities demanded of him by his colleagues in other fields. He referred to the extent that modern engineering progress had been assisted by the result of work in metallurgical laboratories, and indicated that further metallurgical investigation and study were needed to show how best to apply.*

Prof. Thompson then briefly referred to the growth of the Institution itself. The pessimism shown by some of the founder members in the early days, believing that prosperity and rapid growth in the first few years were only temporary, had been proved unwarranted. Growth had been continuous and, he said, showed little sign of decreasing in rate. This, and the corresponding increase in examinations, provided adequate evidence that the Institution was satisfying a real need, and not only in this country. The new president acknowledged those who had played a part in the guiding of the Institution's policy during the past years.

Specialization in Metallurgy

The continued growth of the Institution was due, Prof. Thompson felt, to its policy in requiring a breadth of knowledge and experience from its members. This was exemplified by the non-specialization exhibited by the type of qualifying examination set. Although the standard expected from candidates had a close comparison with those required for university degrees, the outlook was markedly different. However, he emphasized, successful candidates could be proud of their achievements and they should have no hesitation in claiming to be metallurgists in the full sense of the word. He supported the Institution's policy in maintaining a wide outlook in the initial training of its members, however deep a later specialization in some restricted field may go.

Prof. Thompson, concluding his address, then said "With the growth of all sciences and technologies, the time comes when the individual must, however unwillingly, devote his thoughts and work more and more to some relatively restricted section of his field. Has the time now come when this Institution might take into its consideration the encouragement of what I may term post-graduate studies, by the award of a diploma or other qualification to those who, in addition to the broad training—for which I have already pleaded—have made such further, specialized study of some one of the main branches of our science that they can be regarded as masters in it?

"What I have in mind is, perhaps, not altogether unlike the general American degree of Master, obtained on a course of study which includes a substantial element of experimental work, but, in our case at any rate, *not necessarily research.* But, just as the Master's degree is awarded to those who have already an initial qualification, so should any special award of this Institution be restricted to those who have already been accepted as satisfying one of its own standards for admission.

"Such a diploma, or whatever other title might be considered more appropriate, might exert a most beneficial influence in many directions. It would encourage an Associate, for instance, to continue his studies until, with the lapse of time, he may hope to qualify as a Fellow. It cannot be too strongly emphasized that no such diploma could ever be considered as a substitute to the Fellowship, to which it would be an additional and not an alternative qualification. It could hardly fail to raise the standards of attainment of those working in our industries. It might well provide an additional incentive to the provision of courses of higher standard in the best of our colleges of technology and, for those engaged in industry, to undertake in them in the evening's work of a research nature.

"When this should be done; what are the branches of metallurgy which might be distinguished by such an award; and under what conditions such awards should be made, are questions regarding my own views on which I refuse to offer any observations here. The president is merely at the tiller; it is for the members, through the council, to decide the course."

* See abstract on page 633 of this issue.

South Australian Steel Plans

In his speech at the opening of the State Parliament, Sir Mellis Napier, the Lieutenant-Governor of South Australia, emphasized the South Australian Government's determination to have a steel industry established within the state. He said that the Government had commenced investigations into the possibility of establishing a steel industry independent of the Broken Hill Proprietary Company.

Sir Mellis said that the iron-ore deposits in the Middeback ranges were the state's most valuable mineral assets. It was one of the Government's interests to secure the establishment of a steel industry near the deposits on the shores of Spencer Gulf. The Broken Hill Proprietary Company, however, which holds the leases covering the principal known deposits in the Middleback ranges, did not see its way clear to undertake such a project. If the results of the investigation were unfavourable, the Government would appoint a committee of experts to advise on methods for the state to derive adequate benefits from the deposits.

Metallographic Polishing of Cast Iron: Simplified Method Using Diamond Abrasives*

By L. E. Samuels, B.Met.E.†

The method, which is intended primarily for the more difficult types of specimen containing coarse graphite, is a modification of a general method of metallographic polishing based on the use of diamond abrasives. The essential change is in the use of a napless cloth for the diamond abrasive pad. Results at least the equal of the best previously published methods can be obtained in a relatively short polishing time and with the minimum of skill.

A standard for the metallography of cast iron containing free graphite has been set for many years by Morrogh and his co-workers of the British Cast Iron Research Association; the recent publication[1] of a selection of representative micrographs is proof of the high proficiency attained. Morrogh has described his polishing technique,[2] which owes its success to the correct application of repeated polishing and etching treatments at the finish-polishing stage. With the more difficult types of specimen (*i.e.*, those containing very coarse graphite), however, the repeated polishing and etching process is very laborious, some specimens requiring as many as 30 cycles of treatment. Furthermore, it seems that the process requires some degree of personal skill; the Author has never been able to attain the standard reached by Morrogh.

The Author has recently developed an improved method of routine metallographic polishing based on the economical use of diamond abrasives.[3] Since it is well known that the use of this abrasive greatly facilitates the retention of non-metallic inclusions, and in view of the report by Woodside and Blackett[4] that excellent retention of flake graphite was achieved by a similar method of polishing, it seemed desirable to determine whether the preparation of cast-iron specimens could be simplified by these newer methods. Trials were therefore carried out on a wide range of specimens, and it was confirmed that good results could be obtained by the standard polishing method previously described with most commercial grey cast irons, in which the graphite flakes were relatively fine.[5] Completely satisfactory results could not be obtained, however, with irons containing coarse flake graphite, spheroidal graphite, or, more particularly, temper carbon nodules of the type present in blackheart malleable irons. A modified method, the principles of which are described in the present paper, has therefore been developed for these more difficult types of cast-iron specimen.

Principles of Modified Method

As pointed out by Morrogh,[2] the preliminary abrasion stages play a critical part in the retention of graphite, since only if good retention is achieved at this stage can there be any hope of obtaining a satisfactory final polish. Particular attention has been given to this aspect in the present method, in that the aim has been to obtain almost complete retention of graphite at the end of the preliminary abrasion stages.

In the Author's standard method of polishing,[3] abrasion is first carried out on a series of waterproof silicon-carbide papers lubricated with flowing water, which are followed by a special cast wax-alumina abrasive lap. This treatment is eminently suitable for cast-iron specimens. Firstly, the silicon-carbide papers themselves produce less damage in the graphite areas than the more usual emery papers. Secondly, the wax lap, in which the possibility of loose abrasive is reduced to the minimum, produces a relatively fine finish with maximum retention of graphite; the surface produced on this lap is also very flat with well-preserved edges. Typical examples of the results obtained on specimens containing coarse flake graphite and temper carbon nodules, respectively, are shown in Figs. 1 (*a*) and (*b*). It will be noted that only a few small pits are present in the graphite areas. A comparison of Figs. 1 (*a*) and (*c*), and of Figs. 1 (*b*) and (*g*), also indicates that the graphite areas are free from serious distortion.

It has not been found possible, however, to maintain this degree of retention by a polishing stage in which diamond abrasive is used on a pad of napped cloth. Moderately satisfactory results can be achieved by using a cloth of short nap, heavy polishing pressures, and short polishing times, but such a process is difficult to control and the best results do not compare with those described later. The conclusion was reached that the desired results would be obtained only by the use of a napless cloth, as originally recommended by Vilella.[6] The silk cloth used by Vilella, however, has been found to be unsuitable for charging with the diamond-impregnated carrier paste, as the paste is rapidly pushed through the loose weave of the cloth and thereby lost.

Working Details

Ideally, the cloth should have the minimum of nap and a close weave, so that the abrasive-impregnated paste is retained in the surface layers; furthermore, it should not scratch the surface of the

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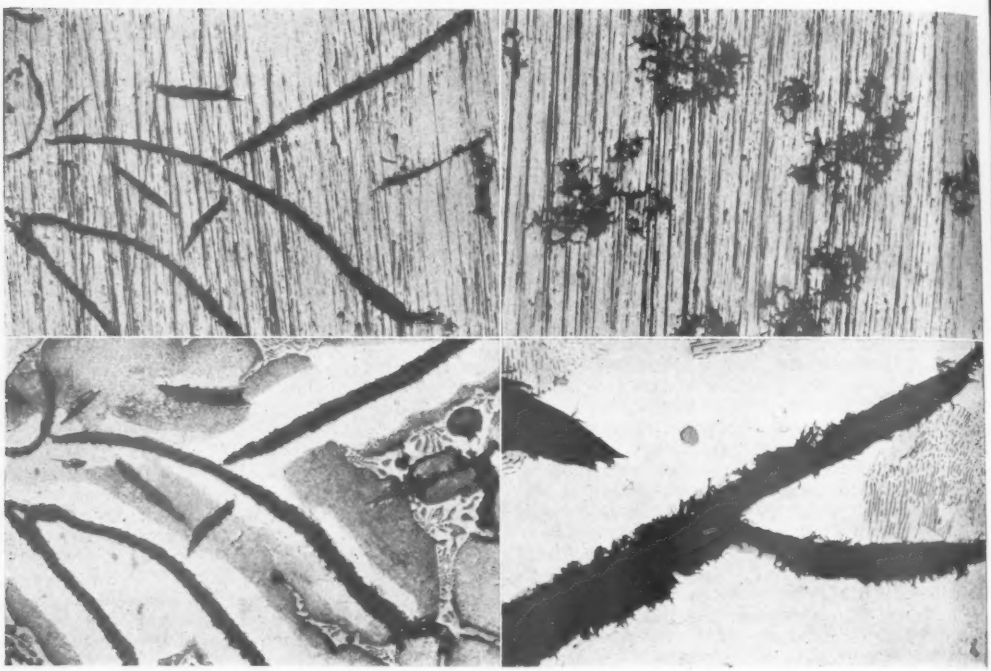


(*a*) *Coarse flake graphite; finished on alumina/wax lap;* × 100.
(*b*) *Temper-carbon nodules; finished on alumina/wax lap;* × 100.
(*c*) *Coarse flake-graphite; finished on diamond abrasive pad; nital etch;* × 100.
(*d*) *As* (*c*), *after finish-polishing on magnesium-oxide pad; nital etch;* × 500.

FIG. 1.—*Photomicrographs of cast-iron specimens.*

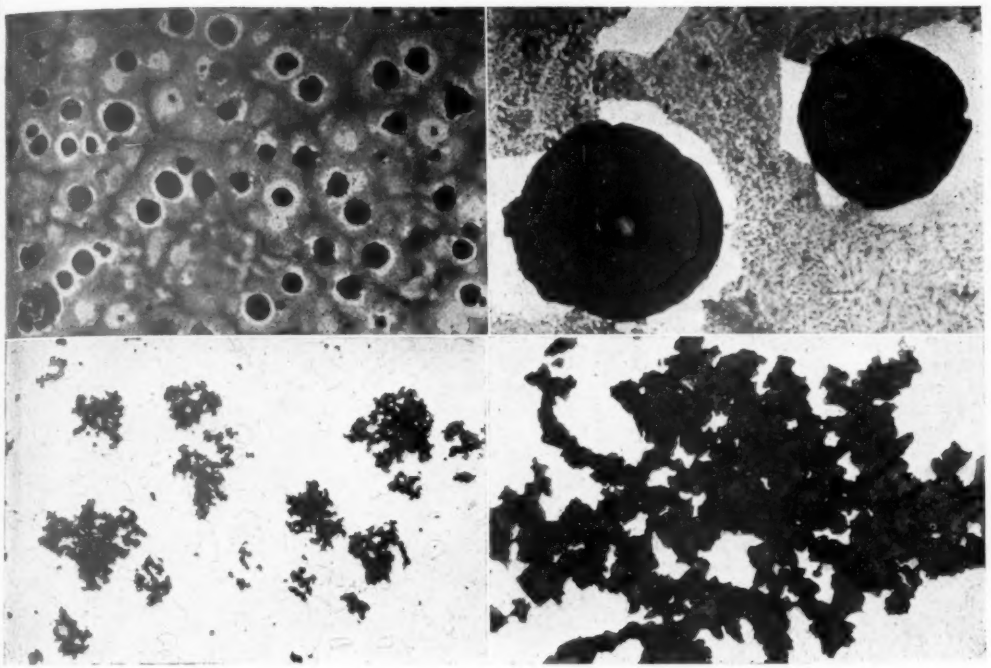
specimen. Of the many types of cloth tested by the Author, none has been found to be completely satisfactory. Heavy cotton drill most nearly approached requirements, suffering only from the following limitations.

The impregnated paste works into the body of the cloth, gradually reducing the polishing rate. Furthermore, the cloth clogs rather rapidly with polishing *débris*, with consequent scratching. In practice, only one or two specimens can be satisfactorily prepared on each charging. In the interests of reasonable economy, the diamond abrasives should be restricted to a single stage, for which a (0-1)μ grade is the most suitable, and the pads should be used as follows:—A small portion of paste, containing 2-3 mg. of abrasive, is spread over and rubbed into a 2-3-in. dia. area of the pad. A few drops of kerosene (light paraffin oil) are added, and the polishing is carried out by hand on this area. It is essential to use a lubricant such as kerosene with which the carrier paste is immiscible (the paste used is a water-base emulsion), otherwise the paste and abrasive are rapidly washed through the cloth. When the pad begins to scratch excessively, the cloth must be washed thoroughly and then dried before being recharged.

The pad requires no special precautions in use and shows no tendency to damage even the coarsest graphite areas. The treatment on the pad may therefore be continued until any preliminary damage to the graphite has been eliminated and the desired degree of retention has been achieved. Since the polishing rate of the pad is very high, the duration of this treatment rarely exceeds 5 min. The specimen may, with advantage, be etched several times during the treatment, but this is not essential. Representative examples of the three main types of graphite after polishing to this stage are shown in Figs. 1 (*c*), (*e*) and (*g*). The flake graphite of Fig. 1 (*c*) is relatively coarse and is typical of the flake size for which the special technique is necessary. The retention of the individual spheroids of Fig. 1 (*e*) is perhaps no better than that normally obtainable on napped cloths; the improvement to be noted is that all the spheroids are completely retained. The best example, however, is the complete retention and the sharp appearance of the temper carbon nodules of Fig. 1 (*g*); these are undoubtedly the most difficult of all the types of graphite to retain.

Final Treatment

The surface produced on the drill-cloth pad in-



(e) Spheroidal graphite; finished on diamond abrasive pad; picral etch; × 100.
(f) As (e), after finish-polishing on magnesium-oxide pad; picral etch; × 1,000.
(g) Temper-carbon nodules; finished on diamond abrasive pad; nital etch; × 100.
(h) As (g), but × 500.

FIG. 1 (CONT.).—*Photomicrographs of cast-iron specimens.*

evitably is lightly scratched. When the pad is in a satisfactory condition, the scratches are never noticeable in micrographs of low magnification, even when the matrix is completely ferritic as in Fig. 1 (*g*); they are, however, usually noticeable in flake or spheroidal graphite areas at high magnifications (say, × 500 or higher). A further finish-polishing treatment may then be desirable, for which a "Selvyt" cloth pad charged with a thick paste of calcined magnesium oxide is recommended; this is one of the two finish-polishing methods recommended by Morrogh.[2]

In the Author's experience, however, such a treatment invariably results in some damage to the graphite no matter how carefully it is carried out. In the case of flake and spheroidal graphite, the damage is slight and many fields are usually of satisfactory appearance at high magnifications; these are the cases where finish-polishing may be used to advantage. On the other hand, temper carbon nodules are seriously damaged by even the briefest finish-polishing treatment, and it should not be used with these specimens. Fortunately, any scratches produced on the diamond abrasive pad are not noticeable in this form of graphite, and a finish-polishing treatment is hardly necessary (see Fig. 1 (*h*)). It is not always appreciated that damage to the graphite is more noticeable at low than at high magnifications. For examination at low magnifications, a finish-polishing treatment has been found undesirable.

A finish-polishing treatment should therefore be used only when absolutely necessary and where previous experience has shown that excessive damage to the graphite areas does not occur. At best, the treatment must be brief (1-2 min. maximum duration) and can be expected only to remove fine scratches from the graphite areas. Consequently, it is of some importance to ensure that a polish free from major scratches is obtained on the diamond abrasive pad. These remarks apply, of course, only to finish-polishing pads used in the normal way, without special skill or care, and not to techniques of the type developed by Morrogh.[2]

Stain Removal

The graphite areas after polishing on either the diamond abrasive or magnesium-oxide pads are usually slightly stained. The best method of removing the stain without further damage is to wash the surface with soap and a piece of material used for the finish-polishing pad. All the specimens

shown in Fig. 1 were washed in this way. These micrographs were taken with a microscope fitted with a Foster-prism illuminator and do not show the slight polarization effects found with microscopes fitted with a plane-glass illuminator.[5, 7] The flat grey appearance of the graphite in these micrographs makes the presence of minor polishing blemishes or stains much more obvious.

Even with the best retention by the polishing methods described, approximately half the spheroids of spheroidal graphite irons contain a roughly hexagonal, lighter core (see Fig. 1 (*f*)). In all such cases, the core was found to be virtually at the same level as the rim, and appeared to be merely a more highly reflecting area in the graphite. It was also found that these areas were the first to be damaged by polishing on a napped cloth. These observations are in conformity with the conclusions of Weld, Cunningham, and Boswell[8] that the core is simply an area at which a basal section of the radial graphite structure is exposed.

Summary and Discussion

The stages of the modified system recommended for polishing the more difficult types of cast-iron specimen (those containing coarse graphite) are as follow:—

1. *Abrasive Papers*

Silicon-carbide waterproof papers using flowing water as lubricant: (*a*) 220-mesh grade; (*b*) 400-mesh grade.

2. *Intermediate Lap*

Cast abrasive/wax lap charged with a (10-30)μ grade of levigated alumina; used dry; hand operated.

3. *Diamond Abrasive Stage*

Paste impregnated with a (0-1)μ grade of diamond abrasive charged on a heavy cotton drill cloth; kerosene lubricant; hand operated.

4. *Magnesium-oxide Stage*

"Selvyt" cloth charged with thick paste of calcined magnesium-oxide. Hand or machine operated. To be used only when found necessary and where excessive damage to graphite areas does not occur.

The system owes its success both to the improved finish obtained on the intermediate wax lap and, of greater importance, to the use of fast-cutting diamond abrasive on a napless cloth. The finish obtained is a compromise in which maximum retention of graphite is achieved at the expense of the presence of light surface scratches. Such scratches are usually not objectionable in these specimens, even under the most critical conditions of photomicrography.

Figs. 1 (*a*)-(*h*) are all of specimens which are ordinarily very difficult to prepare, and the standard of the micrographs is thought to be at least the equal of that attained by Morrogh and his coworkers.[1, 2] The present results, however, are achieved by a much less laborious method, no stage of which requires special skill or care. It is also worthy of note that the technique used is that which has been found to give optimum preservation of the edges of the specimen.[5] A process of alternate etching and polishing on a napped cloth must inevitably result in considerable rounding of the specimen edges.

Admittedly the abrasive costs of this method of polishing are appreciably higher than those for the standard method described previously.[3] The cost per specimen nevertheless is still quite low, particularly when compared with other costs of preparation and photography. In any event the improvement in results more than justifies the increased abrasive costs.

Acknowledgment

This paper is published with the permission of the Chief Scientist, Department of Supply (Australia).

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Need to Integrate Welsh Ports

A suggestion that all concerned with shipping activities should study the possibilities and advantages of developing the South Wales ports as an integrated unit has been put forward by the Joint Ports Committee of the Industrial Association of Wales and Monmouthshire.

A statement by the association says that provided unanimity is reached on the lines along which such a plan might be developed, the committee is confident that the British Transport Commission would consider reasonable recommendations. These would probably include allocating appropriate funds for improving and adjusting the existing facilities to render each port capable of dealing with more traffic as well as providing accommodation and equipment for repairing larger cargo vessels.

"Josephine's" Record

All British records for iron production were broken last week at Dagenham (Essex) when "Josephine," the Ford blast furnace, which is the only one in this country's car industry, produced a total of 2,000.126 tons on one lining. The furnace has only stopped production for 28 days since it was relined in 1944. First blown in during 1934, it also established records on its original lining.

The record-breaking figure exceeds by 483,261 tons the amount produced on the first lining, and is outstanding for the high quality of iron smelted and the comparatively small amount of coke used. The furnace is tapped every four hours, night and day, and the signal for carrying out this operation at mid-day was given by Sir Patrick Hennessy, deputy chairman and managing director of the Ford Motor Company, Limited.

New Equipment

Lift-truck Ancillary

A new hydraulically-operated load-clamping device, shown in Fig. 1, has been specially designed for use with Stacatruc fork-lift trucks and has been developed to provide a positive means of "locking" loads to the forks. It consists of a rigid support structure (designed to take the place of the conventional backguard and therefore capable of easy fitting) upon which is mounted a cantilever bracket in which a simple system of lever and hydraulic ram is enclosed. The

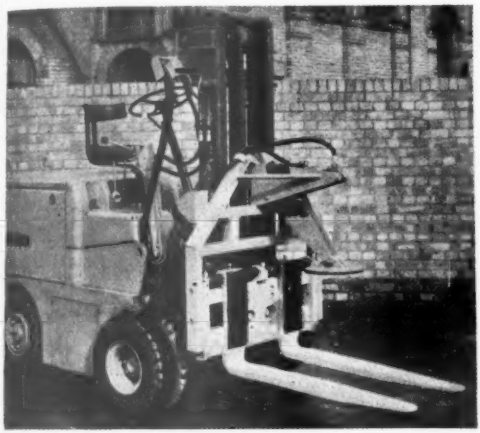


FIG. 1.—*Battery-powered fork-lift Stacatruc fitted with the new load-clamping device.*

outer end of the lever is provided with a suitable clamping plate pivotally mounted to present the maximum area to the load surface. Operated hydraulically by a two-way valve, pressure can be supplied to the double-acting ram to produce upward or downward travel of the clamping plate. Details are available from I.T.D. Limited, at 95-99, Ladbroke Grove, London, W.11.

Widening Technical Education

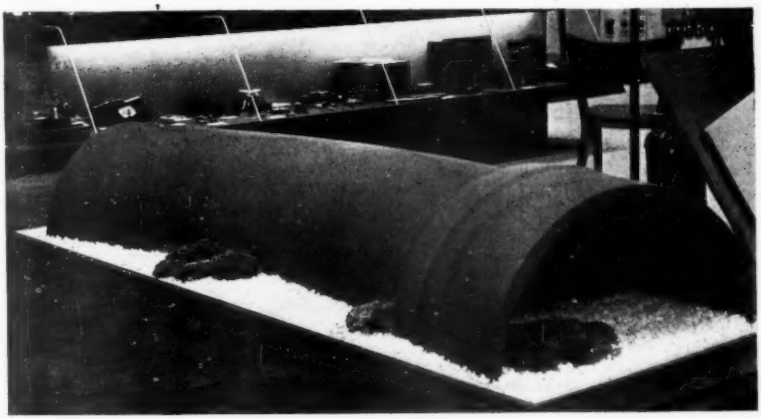
A call for improved opportunities for general studies in technical schools is made in a report published recently by a committee of inquiry, set up by the National Institute of Adult Education (with the Associations of Technical Institutions and of Principals of Technical Institutions) to survey the relationship between vocational and non-vocational further education and training in England and Wales. The most important obstacle to the development of liberal studies, states the report, is the fact that technical Institutions are handicapped by the common belief that they exist to provide technical training only. A second obstacle is the poverty and shortage of accommodation, and a third the shortage of time, which makes non-vocational work practically impossible for evening students. Many technical teachers would welcome an extension of non-vocational studies, and it is clear that in those colleges where attention is given to them students respond well.

The report strongly urges the establishment of county colleges, and states the belief that human relations in industry and commerce should be more widely studied, and that all teachers should attend to their students' use of English. In all full-time vocational courses, including "sandwich" courses, and in part-time day-release courses an effective proportion (one fifth is suggested) of the students' time should be devoted to non-vocational work.

To give liberal studies a status comparable with that of technical studies there should be created in each Institution a department of general studies having a staff, student body, accommodation, and courses of its own. It is imperative that libraries in technical colleges should be improved, and the provision of adequate refectories, assembly halls, including theatre equipment, and recreation and common rooms is essential. Halls of residence are desirable. There should be intimate liaison between technical colleges and residential adult education colleges. Many more travelling scholarships for technical students should be established, and more exchanges of technical teachers with other countries.

GRAHAMSTON IRON COMPANY, LIMITED—Mr. James L. Mitchell has been appointed a director of the company.

The accompanying illustration shows a hollow core for producing cast-iron pipes, made by the Stanton Ironworks Company, Limited, Nottingham, using Bakelite foundry resins. The pipe is 24 in. dia. and the core is made by vibrating the sand/resin mixture from a hopper into a heated corebox, after which it is baked for approximately 25 min.



Vickers Outlook "Reasonably Good"

"A reasonably good year" in 1955 was forecast for Vickers, Limited, by Sir Ronald Weeks, the chairman, at the annual meeting. The aircraft programme was gaining momentum, he said, and the Weybridge and Hurn plants would be kept fully occupied throughout 1955 and 1956 and probably longer. The railway programmes at home and abroad, and the motor industry, should ensure a busy year for the group.

Analysing turnover during 1954, Sir Ronald said that ship building and repairing accounted for 19 per cent., aircraft 20 per cent., and steel 25 per cent., the remaining balance of 36 per cent. being engineering. Orders for heavy engineering products of Vickers-Armstrongs, Limited, were well maintained throughout 1954: during the latter part of that year and during 1955 to date there had been a considerable increase in the volume of orders received.

Referring to the acquisition of all remaining shares in Powers-Samas Accounting Machines, Limited, Sir Ronald said this would facilitate co-operation in production and would undoubtedly facilitate the provision of large sums required for the Powers-Samas production and rental sales programme for the next few years.

Iron and Steel Board Report

The annual report of the Iron and Steel Board for the period July 13, 1953, to December 31, 1954, makes the following comments on iron castings:—

During the period under review supplies of raw materials for iron castings were adequate and there was ample production capacity in all sections of the industry.

During 1952 and the first half of 1953 there had been a recession in demand for iron castings. Demand revived in the second half of 1953. In the last quarter of that year production was nearly 1 per cent. above the corresponding quarter of 1952. This improvement was maintained during 1954 as will be seen from the following table:—

Iron Foundries Output. (Tons.)

	1953.	1954.	Percentage increase.
1st Quarter	956,417	965,751	0.98
2nd Quarter	903,302	925,762	2.49
3rd Quarter	826,896	854,121	3.29
4th Quarter	951,814	996,858	4.73
Total	3,638,429	3,742,492	2.86

Demand in 1955 may well show some further increase for which foundry capacity should be ample. The growing requirements of hematite and low-phosphorus foundry iron, especially for high-grade engineering castings, appear to be throwing some strain on supplies.

TWEEDALES & SMALLEY (1920), LIMITED—Lord Jessel, who is a director of Textile Machinery Makers, Limited, has been appointed to the board.

B. ELLIOTT & COMPANY, LIMITED—Mr. Jack Frye has been elected chairman of the company in place of Mr. Hugo Frye, who has retired from that office, but continues as a director. Mr. C. H. Frye has been elected vice-chairman. Mr. J. W. Blackshaw and Mr. E. W. C. Kelleher are joining the board as from July 1.

India's New Ministry of Iron and Steel

"In view of the importance of developing and expanding the iron and steel industry," the Indian Government has created a new Ministry of Iron and Steel. Mr. T. T. Krishnamachari, Minister of Commerce and Industry, will also be in charge of the new Ministry, which will control State-owned foundries and the Government's industrial undertakings in iron and steel production. India proposes to produce 6,000,000 tons of steel yearly—against the present output of 1,300,000 tons—by the end of the second five-year plan in 1962. She plans to achieve this target by increasing the production of her existing three plants and by setting up three more, two of them State-owned. Ownership of the third is yet to be determined.

One of the new plants is to be established at Tourkela, in Orissa, by a German steel firm. The second, in the Bhilai area of Madhya Pradesh, will be supplied by the Soviet Union on credit repayable at a low rate of interest over 12 years. Indian technicians are to be trained in Russia.

A British steel mission, under the leadership of Sir Eric Coates, which visited India recently, is expected to submit its report next month on the best site for a British steel plant to be set up in India. The plant will have a capacity of 1,000,000 tons of steel ingots annually. Last February, a Czech trade mission also offered to supply India with a steel plant.

Wages Rise in April

According to the "Ministry of Labour Gazette," the index of weekly wage rates rose by two points last month to 151 (June, 1947 = 100). This index has now risen by five points in two months compared with an increase of four points throughout 1953 and a rise of five points in 1954. The retail prices index (June, 1947 = 100) rose by one point to 147 between March 15 and April 19 of this year, after remaining steady at 146 throughout the first quarter.

During April about 2,470,000 workers secured wage increases of about £996,000 a week, coal mining being one of the main industries affected. This year to date 9,000,000 workers have received an estimated increase of £3,450,000 in weekly wages. In the same period of 1954, 5,900,000 workers received rises of £1,660,000 a week.

Industrial disputes in April cost 214,000 working days, compared with 149,000 in March and 74,000 in April, 1954. Disputes in the coal-mining industry lost 83,000 working days.

High Level of Output in April

During April industrial output in the UK continued the rapid rate of advance achieved in the first quarter of the year. According to estimates prepared by the Central Statistical Office, the index figure for all industries last month was 130-131 (average 1948=100), compared with 124 in April, 1954. This brings the total rise in the first four months of this year on the January-April period of 1954 to little below 6 per cent.

The all-industries index, however, was below the figures achieved by manufacturing industry alone. In the first quarter of this year, output in manufacturing industry was 7.7 per cent. higher than in the first quarter of last year, but other industries did not achieve the same high standard, production in mining and quarrying, for instance, having recorded a fall so far this year.

Metallurgical Research Projects at the NPL, Teddington, Middlesex

Progress During the Last 12 Months

The past 12 months have been an eventful period for the National Physical Laboratory at Teddington, Middlesex. Official visits were made by the King and Queen of Sweden, by the Royal Commission on the Civil Service, and by members of the joint meeting of the Institute of Metals and the *Société Française de Métallurgie* in the autumn. The new building of the Metallurgy Division was formally opened by Sir Lawrence Bragg, F.R.S., last year, and contains the refractories and X-ray section, and laboratories for work on radioactive tracers. The facilities created by this extension have already been described in the JOURNAL, June 10, 1954.

The extension has proved to be an effective laboratory, and much appreciation has been expressed of its lighting and of its colour schemes. The apparatus in the X-ray section is in constant use, and includes two continuously evacuated X-ray tubes, a fine focus X-ray tube, three sealed off X-ray tubes for general use, two Geiger-counter diffractometers, an electron microscope and a soft X-ray spectrograph. In the radioactive tracer laboratory, attention is still being given primarily to the development of technique, but application of tracer methods to metallurgical problems has now commenced.

In June, a three-day international symposium was held by the Metallurgy Division on the subject of creep and fracture of metals at high temperatures, at which 148 delegates attended, representing some 12 nations.

A very large programme of research has always been maintained by these laboratories, and the possibility of reducing the items to be studied in order to enable more rapid progress to be made with the remainder is being considered. It is also possible that this reduction will enable a start to be made on a few new urgent items.

The annual open day was held recently when an opportunity was provided to inspect the laboratories and some of the work in progress and to discuss relevant problems. The following review describes some of the exhibits and gives brief details of the progress made in some of the research problems studied in the Metallurgy Division.

Intercrystalline Fracture

A great deal of attention has been paid to intercrystalline weakness of metals and alloys during the past year. It has been found that it can be developed in many iron alloys in which its presence had previously been unsuspected and that it obeys complex rules of a somewhat unusual type. It has been shown that the weakness develops in nitrogen-containing iron that has been heated for a very short time at about 700 deg. C. and subsequently quenched. If the material is sufficiently slowly cooled from 700 deg. C. the weakness is not present, and if the rapidly cooled material is reheated either to a high temperature such as 900 deg. C., or a moderate temperature such as 400 deg. C., the weakness is wholly or partially removed.

The weakness is exceptional in that it becomes progressively more serious as the temperature at which the material is tested is lowered. When the weakening is extreme, the material is fragile at room temperature, breaking as a rule shortly after the yield point has been reached, and its breaking strength decreases uniformly as the temperature is lowered. The breaking strength of normal material increases when the temperature is lowered.

The potential significance of the phenomenon in relation to the failure of steel structures at low temperature is obvious, but its real importance remains to be assessed. Although the brittleness rarely occurs when carbon and manganese are present, it may prove that these elements only retard the reactions by which it is produced, and do not eliminate it entirely. Much work on the dynamics of the embrittlement has still to be done. Since the heat-treatments that produce the brittleness are similar to those often employed to soften a steel and relieve internal stresses, it appears to be quite possible that slight brittleness of this kind has occasionally been present in commercial steels, and though undetected by normal methods of test, has been sufficient to cause failure in certain exceptional circumstances.

The impurities responsible for it appear to be in solid solution in the iron both in the tough and the brittle condition, and a segregation of some impurity to the grain boundary seems to be involved. In this respect the brittleness resembles a brittleness which has been studied in alloys of copper and antimony.

Fracture in Fatigue

The need for an advance in the fundamental knowledge of the fatigue of metals is very great, and it was decided to study the nature of the changes in repeatedly stressed metal that lead ultimately to the production of the fatigue crack. It has generally been considered that the major part of the " fatigue life " of a component is consumed in the initiation of fatigue cracks, and that once a visible crack has been produced, the subsequent life of the component is short. By means of the dynamic strain extensometer recently developed in the NPL, it has proved possible to define closely the time at which the crack was formed and, for the particular sample of steel under examination, it has been proved that the endurance of the specimen after the crack has appeared is less than 5 or 10 per cent. of the total endurance.

In order to study more closely the changes that occur in the period preceding the formation of the fatigue crack, a fine focus X-ray tube has been used for the observation of low angle scattering from chosen small areas. Effects have been observed,

Metallurgical Research Projects at the NPL, Teddington, Middlesex

which can be interpreted as being due to the formation of regions of changed electron density in the range of dimensions of 50-150 Å. These effects are to be systematically examined.

Resistance to High-temperature Creep

Much more has been done on the creep tests up to 10,000 hours on austenitic and ferritic tube and pipe steels and on molybdenum-vanadium steel castings, and of relaxation tests up to 10,000 hours on a variety of ferritic bolt steels. Considerable progress has been made in the study of creep-resistant ferritic steels containing 6-9 per cent. of chromium. When alloyed with suitable proportions of molybdenum, titanium and carbon, these steels show a very useful degree of strength at temperatures above 600 deg. C. It has been shown that these steels can be considered for use in some situations where the more expensive austenitic stainless steels have hitherto been considered necessary. A precipitation hardening heat-treatment is required to obtain the best results, and chemical separation of the precipitated particles, followed by examination by electron microscopy and electron diffraction, has proved to be very useful in studying the nature and size of the particles.

The Electrical Research Association realizes in its future projects many metallurgical problems. Among them is the probable use of steam temperatures up to 649-760 deg. C. Exploratory tests on tube and pipe materials suggested for the highest temperatures will be needed, and much additional work will also be required on components which hitherto have operated at moderately low temperatures, but under the new conditions will operate at temperatures at which creep resistance must be taken into account.

Metallographic studies have been undertaken of the changes in structure of the materials subjected to the 10,000-hr. creep tests. This work, which necessarily follows the completion of the creep tests, has been much assisted by X-ray examination of the carbides formed in the samples. The same technique has also clarified the behaviour of molybdenum, molybdenum-vanadium and molybdenum-chromium steels.

Properties of Materials at High Temperature

Work on the effect of vanadium-containing fuel ash on the creep and fatigue properties of some heat-resisting alloys has been completed. Both the creep and fatigue properties were adversely affected. Some measure of protection was afforded in particular cases, by chromizing, chrome-aluminizing, or siliconizing, but eventually the corrosive medium penetrated through cracks which developed in the protective coating.

Some further progress has been made in the development of creep testing techniques at temperatures up to 1,400 deg. C. Attempts are being made now to simplify the test-piece form and to render the procedure more economical, so that appreciable numbers of test-pieces may be tested conveniently. These test-pieces will be of sintered material composed of hard compounds of high melting point embedded in a metallic matrix, for certain materials of this kind show promise of maintaining useful strength at very high temperature. A systematic study of the effect of the size, distribution and proportion of the hard particles has been planned, and the preliminary work on the method of preparing the necessary samples has commenced.

Titanium

A change has come over the titanium situation during the past year. Whereas the metal has hitherto been studied as one which might become important in the future, it is now wanted for practical application at once, and questions of immediate urgency arise. Large-scale commercial transactions in titanium are beginning to take place, and it becomes necessary for buyer and seller to agree on the analysis of the material, and attention has had to be given to methods of analysis, methods of sampling and referee analyses.

The constitution of titanium-oxygen and titanium-iron-oxygen alloys has been studied, special attention being given to the determination of the melting range of the alloys, and for heat-treating and quenching small metallographic specimens accurately at very high temperatures. The results amplify, confirm, and in some details correct recent American work on the same systems. A partial study of the titanium-aluminium-oxygen system up to about 1,200 deg. C. is in progress.

Creep and fatigue tests are in progress on commercial titanium alloys suitable for use in gas turbine compressors.

In view of the growing interest in electrolytic methods of producing titanium, some exploratory experiments on the physical chemistry of the electrolytic process have been made and assistance has been given to a firm in assessing the quality of their metal produced by an electrolytic process.

Refractories

Much time has been spent during the last 12 months in completing the installation of the refractories section into the new building, and appreciable progress has been made. A coal-gas compressed-air furnace in which the flame enters the furnace under an alumina floor has been designed and built, and run at temperatures up to 1,650 deg. C. The heating is more even and better controlled than in the old type of injector furnace.

An apparatus for comparing the tensile strengths of materials above 1,700 deg. C. has been set up, and some preliminary trials made. Many problems have been encountered in preparing specimens of suitable form for the work, and rapid and accurate methods of recording the high temperatures have yet to be developed.

Further research in progress in these and other fields is referred to in some detail in the 1954 Report of the National Research Laboratory, DSIR, published by HMSO (price 4s.).

Price-maintenance in the Last Century

By T. R. Harris

It is generally thought that industry in the last century was conducted on the principle of cut-throat competition, but evidence has just been examined which tends to point to co-operation among a number of foundries, in one particular locality, at least. This evidence is contained in a number of letters written by William Wilson, the manager of the Perran Foundry Company, to the proprietor of the Hayle Foundry. A number of relevant extracts are given in what follows to illustrate the extent of this co-operation between these two foundries, together with the Copperhouse Foundry, under the management of John Pool.

Situated in the midst of the metalliferous mining district of Cornwall, these foundries were called into being to supply the castings required by the mines of the neighbourhood quicker than they could be obtained from South Wales, or the Midlands. By the 1830s the foundries were well established.

Joseph Price, the proprietor of the Neath Abbey Iron Works in South Wales, was also a shareholder in the Perran Foundry Company, and wrote to the proprietors of the other two foundries, from Perran Wharf on the 16th 1st Mo. 1830:—"Esteemed Friends, On examining the prices at which Castings and Engine work are charged at our foundries in this County, I am convinced they are not remunerative for the Capital and time employed and that it is only just that an alteration should be made. I am fully aware of the impediments to such alteration nevertheless I am disposed to invite yourselves and your neighbours to a candid consideration of the subject and our foundry Co. here will have pleasure in meeting the principals or authorized Agents in yours, at Redruth, on the 21st inst. at Andrews at 11 o'ck. Soliciting the fav. of a prompt reply to this place."

Seven months later, Wilson wrote: "I went to Redruth this day almost purposely to see you respecting a tender for Wh. Droskar Engine; the fact is I wish to make a tender but do not desire to get the contract if therefore you will favour me by letting me know your price I take care to be from 20 to 30 pounds *above you* and you may then give us any part you please to execute, or as we may hereafter agree on . . . I am not anxious for any part but possibly Mr. Fox on his return home may be pleased at an offer from you of some small part."

Not only did these foundries make work for the immediate locality but often tendered for, and executed, contracts for other parts of the kingdom. In March, 1832, Wilson informed his friends: "We have seen specifications and drawings of Gas apparatus to be erected at Bridport and shall be glad to learn if you have also been applied to and have any intention to engage in it, in which case perhaps you will have no objection to meet and consult respecting a joint tender, when we may agree on our respective parts, terms, etc."

In May, 1833, the Perran Foundry Company were expecting an order for a 60-in. pumping engine and, being rather full of work, they required the cylinder and cylinder case to be made elsewhere, and consequently made contact with their friends at Hayle asking for their price for these articles, delivered at Perran. In the course of the letter containing the above enquiry, Wilson wrote: "You will also oblige me much by stating your usual charge for feed plunger complete and regulating nozzles and also your charge per lb. for working gear and parallel motion. . . . I perceive by our late regulation of prices that piston and air pump rods are named at 6d. per lb. is not this too low—for small ones in particular—as even before the advance of iron we have charged rather more . . .?"

During the latter part of 1833, the Perran Company had produced some special castings for a nearby mine. As this work was out of the ordinary and no price had been placed on this type of work, the foundry made a charge which was considered fair and equitable, but which the customers refused to pay. Thus in December Wilson wrote: "In Sept. and Oct. last we sent to Tresavean Mine 8 cast iron Rings 6 ft. and 6 in. diameter and weighing from 9 to 10 cwt. each with 15 dovetailed cores in each ring for the cams, cast close in green-sand. For these Rings I have charged 12/- per cwt. and which I thought a very reasonable charge considering that they are of unusual dimensions and such as we never cast before and without any price mentioned on our list. I now find they want to cut our bill to 10/- per cwt. which I have remonstrated against and I understand they mean to apply to yourselves and Copperhouse Co. for your opinions. I shall feel much obliged by your dropping me a note with your sentiments as to the price. I write Mr. Pool to the same effect by this post. . . ."

NORTH EASTERN MARINE ENGINEERING COMPANY, LIMITED—Mr. G. Yellowley has been appointed to the board.

ATLAS DIESEL COMPANY, LIMITED—Mr. A. E. Morgan, the company's works manager since 1946, has been appointed to the board.

A CANADIAN ORDER, valued at over $1,000,000, has been placed by the Manitoba Hydro-Electric Board with the Metropolitan-Vickers Electrical Company, Limited. The contract covers the third and fourth 33,000-kw single-cylinder turbo-generator sets for a new power station at Brandon, near Winnipeg, and brings the total capacity of generating plant ordered for this station to 132,000 kw, the first two units having been ordered from Metrovick last year.

Publication Received

British Non-Ferrous Metals Research Association. In order to commemorate the 25th anniversary of the establishment of the laboratories at Euston Street, the Association has published a particularly pleasing and attractive brochure. It runs to 48 pages, and is well illustrated. After a foreword by the chairman of the Council, Dr. Maurice Cook, there is a history of the Association dealing with such matters as membership, income, the laboratories, general organization and staff. A short section is devoted to the work of the three main departments: Research, liaison and information. Obviously, the central theme of such a brochure is that of research achievements, and to this are devoted some twenty pages. Included in them is the help which has been given to the foundry industry. This includes the nitrogen gassing of alloys, the use of thermally insulating feeder heads, the elimination of pitting in aluminium plumbing systems. Because it does not enter in the province of research, the great service that the Association has rendered to the foundry industry by investigating the shell-moulding process and publishing—in conjunction with the Association of Bronze and Brass Founders' Association—the results, is not mentioned.

Working as it does for so many industries, the reviewer throws out the suggestion that the Association by publishing a series of booklets covering what it has done and could do—if adequately supported—for foundries and sections of the non-ferrous industries would be more than welcome.

Finally, this occasion presents us with the opportunity of congratulating the Association on the completion of twenty years of sterling work carried out for the benefit of the industries it serves so faithfully.

COLT VENTILATION, LIMITED, of Surbiton, have placed their private aeroplane at the disposal of the Government for the duration of the railway strike.

SOUTH DURHAM STEEL & IRON COMPANY, LIMITED, is having a new test house, offices and laboratories erected off Brenda Road, West Hartlepool, Co. Durham.

House Organs

Nickel Bulletin for April, 1953. Published by the Mond Nickel Company, Limited, Thames House, Millbank, London, S.W.1.

In this issue attention is directed to a number of important papers relating to the properties and uses of spheroidal-graphite cast iron of pearlitic, ferritic and austenitic types. The importance of high-temperature corrosion is emphasized by a paper on the metallurgical aspects of dry corrosion and by a report on the resistance of typical nickel-base and other alloys to scaling and to attack of vanadium pentoxide. Increasing interest in the welding and brazing of high-temperature and corrosion-resisting materials is demonstrated by a number of major papers on this aspect.

Sif-Tips, Vol. 18, No. 89. Issued by the Suffolk Iron Foundry (1920), Limited, Stowmarket, Suffolk.

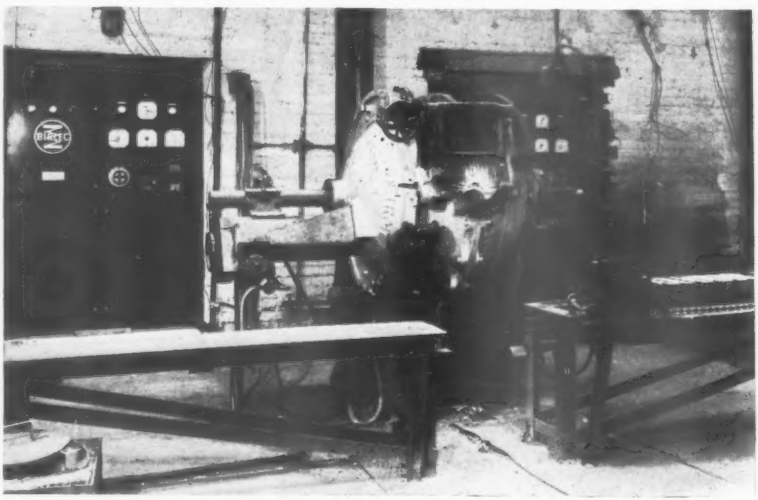
This issue raises the curious question as to whether—following an American suggestion—the word welder should be deemed to mean a welding machine, and that the operator who carries out the process should be called a weldor. Reasoning by analogy it would seem that in the future a moulding machine would be a moulder and the craftsman a mouldor. A baker would be known as bakor and a printer as printor. On these grounds we dismiss the suggestion with the contempt is deserves. This issue carries some nice examples of repairs to castings.

Conversion Chart

An extremely useful inches/metric, metric/inches conversion table has been received from Advance Motor Supplies, Limited, The Green, Twickenham, Middlesex. It is available to readers on writing to the above address.

A MEETING of the Merseyside and North Wales branch of the Incorporated Plant Engineers will be held on June 16, at the Royal Institution, Colquett Street, Liverpool.

The accompanying illustration shows a model LFY Detroit furnace, rated at 225 kva and with a capacity of 500 lb. used for non-ferrous alloys. This equipment is of the nose-tilting design. One of these furnaces is on show at the exhibition which the Midlands Electricity Board, in co-operation with Birlec, Limited, is currently staging at Chester Street, Aston, Birmingham, 6, from 10 a.m. to 12 noon and 2 p.m. to 4.30 p.m. daily until June 17.



"First Book on Metallurgy"

Extract from Prof. Thompson's Presidential Address to the Institution of Metallurgists

Professor F. C. Thompson, M.SC., D.MET., F.I.M., in his presidential address to the Institution of Metallurgists, said that in 1640 the first book on American metallurgy was published in Madrid.* The Author, Barba, a Roman Catholic priest stationed at Potosi in Bolivia, discusses, and obviously from first-hand experience, the whole field of metallurgy of that region. Although the book is said to have been banned and burnt by the Inquisition, three copies are stated by the translators to be known, all in the British Museum. In one chapter, "*Which Treats of what the Metallurgist should be, and what He must Know*," Barba says:—

"Most weighty is the Confidence placed in the Metallurgists, because all the Riches produced by this most prosperous Land are entrusted to them, without reckoning or Account of what part thereof they are bound to return. Their Reputation is the only assurance of their Truthtelling as to what the ores have yielded. There is neither dispute over their sentence nor appeal from it; which is the strongest of Reasons why the urge of their own Interests may incite them to take of the yield unto themselves. Much need of a Christian Honour have they who enjoy these endless Opportunities, having, as the saying goes, 'their hands always in the Dough,' lest some of it stick. With much caution should one look upon him who he would charge with the task of treating his Ores, because there is no bad Substance which might hinder recovery, nor any consumption or loss of Quicksilver (both frequent and sure causes of Loss) which can cause such loss as a Metallurgist with a bad Conscience.

"Nor is it alone sufficient that his good Habits be examined and approved, if there is lacking the necessary Knowledge of the Art which he must exercise. He must be able to recognize the Ores, their qualities and differences; to determine which are most fitted for Amalgamation and which for Smelting, or if there should be a combination of the Processes. He should know the harmful Substances which accompany ores, and not be ignorant of the way to remove them. He should know the Accidents which may happen to Quicksilver, and the ordinary way of milling on a small scale. And, in all cases, he only can be considered as a treater of Ores, who knows at least how to make a small-scale Fire-assay of finely crushed Ore before amalgamating, in order to determine the Silver contained, and to know of a certainty and not through guesswork what he should recover. No Diligence should be omitted to secure this result."

Professor Thompson continued by saying that summarized in modern terms, the metallurgist should be an honest man, of wide experience, who *does* know his job. Though Barba wrote nearly three-and-a-quarter centuries ago, could a better specification for any professional man be drawn up even to-day? Barba, though he could never have envizaged an Institution such as our own, would have welcomed it wholeheartedly. "The treatment of ores," he says, "should not be practised except by him who understands it, and after Examinations and Lincense of the Authorities." Examinations then are not new things, nor are the practical or oral tests to which he probably refers.

* "El Arte de los Metales" Alvaro Alonzo Barba, Madrid, 1640. Translated by Ross E. Douglass and E. P. Mathewson. John Wiley and Sons, New York, 1923.

Research on Ingot Cooling

Electronic recorders furnished by Honeywell-Brown, Limited, 1, Wadsworth Road, Perivale Road, Greenford, contributed to the success of a series of investigations on the cooling of 15-ton ingots between teeming and stripping. The investigations were undertaken at the Steel Company of Wales, Limited, by the fuel-technology section of the British Iron and Steel Research Association. Fig. 1 shows the mould train used for the experiments. In front is the bogie on which the couples were situated, the recorders being housed in a separate cabin. The experiments required a continuous record of temperatures transmitted by the 152 thermocouples in the test mould and bottom-plate. Mould temperatures expected to change rapidly were recorded on a high-speed recorder in conjunction with a 48-point switchbox; 2½ min. were required for a complete printing cycle. The remaining mould and cap temperatures

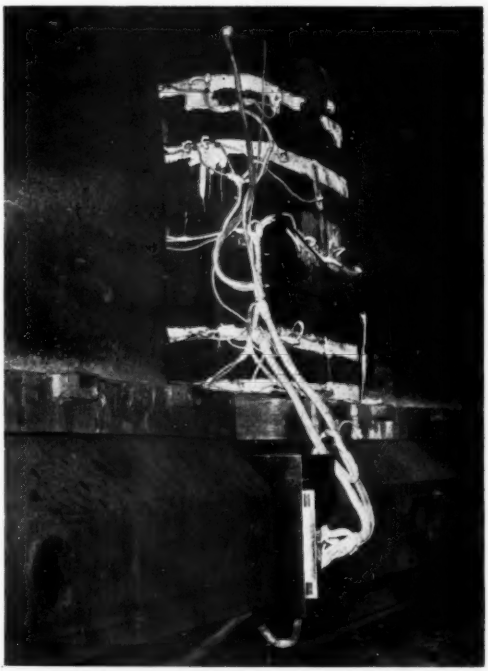


FIG. 1.—*Mould train and the thermocouple set-up used for research on ingot cooling at the Steel Company of Wales, Limited.*

were recorded on a second high-speed recorder using 96 points of a 144-point switchbox. A medium-speed recorder and a 24-point switchbox were used to record bottom-plate temperatures. The experiments have made it possible to recommend a reduction in standing time between teeming and stripping which will lead to a saving of fuel in soaking pits and an increased mould life. This is a very satisfactory result of trials carried out under unusually arduous conditions. Analogous with these experiments on the casting of steel ingots it is possible to visualize numerous applications to foundry research where multi-point and high-speed recording of a similar nature could be employed.

Imports and Exports of Iron and Steel in April

The following tables, based on Board of Trade returns, give figures of imports and exports of iron and steel in April. Totals for the first four months of this year and last are also included.

Total Exports of Iron and Steel

Destination.	Month ended April 30.	Four months ended April 30.	
	1955.	1954.	1955.
	Tons.	Tons.	Tons.
Channel Islands	364	1,418	2,333
Cyprus	296	2,043	1,654
Sierra Leone	1,024	5,274	3,037
Gold Coast	1,806	14,286	9,334
Nigeria	4,646	19,321	15,263
Union of South Africa	6,477	13,343	30,359
Rhodesia and Nyasaland	5,653	16,686	24,804
Tanganyika	1,255	3,750	4,821
Kenya	2,207	23,842	18,564
Uganda	184	2,619	1,563
Mauritius	167	2,664	839
Bahrein, Qater, and Trucial Oman	1,709	10,268	4,974
Kuwait	233	3,037	1,418
India	8,673	30,357	48,140
Pakistan	1,539	16,751	19,117
Singapore	3,451	10,375	14,133
Malaya	2,337	8,490	7,045
Ceylon	1,279	5,292	6,925
British North Borneo	748	1,174	1,597
Hongkong	4,340	6,106	17,062
Australia	32,860	70,505	163,453
New Zealand	24,502	58,804	97,758
Canada	8,093	58,860	29,131
Jamaica	1,507	4,671	4,379
Trinidad	1,708	13,989	18,043
British Guiana	584	1,483	2,261
Anglo-Egyptian Sudan	460	11,781	5,997
Other Commonwealth countries	2,437	8,667	12,580
Eire	4,602	15,762	19,361
Finland	4,984	18,156	25,633
Sweden	11,552	26,370	47,848
Norway	9,806	28,081	44,183
Denmark	5,258	31,144	28,059
Western Germany	63	2,048	2,305
Netherlands	6,816	32,299	35,883
Belgium	2,259	3,788	7,550
France	249	1,767	2,161
Switzerland	1,535	3,748	5,665
Portugal	1,173	3,719	4,371
Spain	9,085	1,358	22,583
Italy	2,532	19,630	9,276
Austria	312	456	976
Yugoslavia	3,334	1,710	8,294
Turkey	1,015	4,112	3,437
Netherlands Antilles	1,408	1,576	4,676
Portuguese E. Africa	156	939	574
Lebanon	472	568	727
Israel	713	4,015	3,677
Egypt	583	14,697	11,356
Saudi Arabia	468	1,049	3,529
Iraq	2,303	12,554	8,922
Iran	3,652	1,774	17,156
Burma	1,290	3,440	5,331
Thailand	358	2,883	1,872
Indonesia	152	2,053	1,235
Philippine Republic	782	1,642	1,845
USA	3,607	8,504	14,814
Colombia	388	2,235	2,942
Venezuela	1,681	11,413	22,933
Ecuador	94	972	853
Peru	741	1,044	3,168
Chile	86	452	469
Uruguay	178	7,272	3,298
Argentina	6,993	25,495	23,908
Other foreign countries	6,429	28,784	18,996
TOTAL	217,648	753,365	986,500

Total Imports of Iron and Steel

From	Month ended April 30.	Four months ended April 30.	
	1955.	1954.	1955.
	Tons.	Tons.	Tons.
Australia	—	6,050	7
Canada	15,829	1,757	28,903
Other Commonwealth countries and Eire	2,940	2,254	4,416
Soviet Union	27,542	63,207	71,148
Sweden	2,364	11,711	10,215
Norway	5,110	9,353	24,043
Western Germany	2,941	39,487	8,472
Netherlands	6,046	34,292	37,943
Belgium	12,069	18,168	33,031
Luxembourg	3,164	8,136	9,626
France	25,451	29,070	55,944
Italy	1	2,689	73
Austria	7,564	75,536	43,556
Japan	—	15	1,257
USA	72,681	36,109	211,199
Other foreign countries	4,526	143	4,635
TOTAL	188,228	337,977	544,468
Iron and steel scrap and waste, fit only for the recovery of metal	101,101	286,094	378,663

Exports of Iron and Steel, by Products

Product.	Month ended April 30.	Four months ended April 30.	
	1955.	1954.	1955.
	Tons.	Tons.	Tons.
Pig-iron	4,445	3,889	20,143
Ferro-columbium (nioblum)*	2	—	39
Ferro-tungsten	22	156	162
Other ferro-alloys†	290	4,053	949
Ingots, blooms, billets, slabs, sheet and tinplate bars	304	1,278	2,739
Iron bars, rods, angles, shapes, and sections	203	878	1,432
Steel bars, rods, angles, sections, and shapes	32,999	95,449	156,827
Iron plates and sheets	13	313	49
Universal plates	634	2,334	3,735
Steel plates, ⅛ in. and under ¼ in.	2,318	3,629	7,511
Do. ¼ in. and over	25,112	49,450	100,741
Black sheets and black plate	18,637	67,344	83,307
Hoop and strip	6,909	38,506	40,724
Tinplate	28,662	104,389	116,451
Tinned sheets, terneplate, and ternesheets	301	854	1,018
Decorated tinplate	268	778	1,050
Galvanized sheets	15,363	55,057	58,719
Other coated plates and sheets	1,769	2,864	5,073
Railway and tramway construction material	16,901	81,128	88,970
Wire rods	2,388	10,154	11,861
Wire	8,679	24,602	39,009
Tubes, pipes, and fittings	50,765	199,397	241,024
Iron castings	161	4,157	3,099
Steel castings	163	1,398	678
Forgings	340	1,288	1,190
TOTAL	217,648	753,365	986,500

* Not separately distinguished before 1955.
† The figures for 1955 are not completely comparable with those for previous years.

FIVE HAULAGE CONTROL UNITS for the small electrical railways in the South African mines have been stowed away in the hold of the Clan MacTavish, which sailed last week from the Clyde. The units have been made by Nelson's of Mossend, Lanarkshire, who claim South Africa as their outstanding overseas market. More than 29 of these control units have already been shipped to the Union.

THE EXPORT CREDITS GUARANTEE DEPARTMENT announces that its Leeds office took over new premises at Weetwood Chambers, 93a, Albion Street, Leeds 1, on June 2.

Selective Absorption of Phosphorus by Steel in the Acid-lined Cupola Furnace

*By W. S. Williams**

In the course of experiments on the production of steel by the oxygen lance, steel being first melted in the cupola furnace for this purpose, difficulties were continually being experienced with the high percentage of phosphorus in the product.

A process of elimination was adopted which entailed analyzing of every single addition to the furnace. There was also the consideration of a possible connection between the high phosphorus content of the steel and the fluctuating balance, known to exist in certain circumstances, between the phosphorus held in the slag cover of the molten metal and in the metal itself. The entry of phosphorus was eventually traced to a pick-up from the slag adhering to the walls of the cupola furnace, but chiefly from the slag adhering to and surrounding the bed-coke, each containing phosphorus but at a stage of concentration not exceeding 0.08 per cent. The bed-coke would, of course, eventually be the repository of all phosphides from the coke used, and for this reason no bed-coke should be passed through the cupola a second time. Striking proof of the folly of such a course was afforded by a simple experiment. A skipful of bed-coke from an accumulation put aside for the purpose was fed into a cupola in which a steel cast was being prepared for an oxygen blow. The cupola had been relined a few days before and one steel cast had already been tapped from it. Analysis of that steel showed the phosphorus content to be 0.085 per cent., but in the present instance it was 0.38 per cent., *i.e.*, nearly five times as much, and this was all attributable to the re-use of the bed-coke.

Unusual Features

There are, however, some remarkable features attaching to this observation which make the phenomenon worth recording. The steel was melted in the course of these experiments at the end of a day's cast after hematite iron, weighing approximately 30 tons plus a 5 per cent. addition of machinery scrap, had passed through the cupola. The phosphorus content of the hematite was 0.06 per cent., that of the scrap a maximum of 0.3 per cent., yet the phosphorus content of the steel product was as high as 0.38 per cent.! This high figure cannot possibly be accounted for unless the assumption is made that there is a progressive and cumulative extraction of phosphorus by the steel from the slag on cupola walls and from the slag on the bed-coke, the phosphorus content of neither of these being ever higher than 0.08 per cent., even when the phosphorus in the steel product was as high as 0.38 per cent.

This view received subsequent confirmation from experiments which will be described later. In the meantime, it should be noted that these results were not isolated instances of unrelated phenomena but were features of day-to-day experiments which could be repeated at will.

It is known, of course, that the basic-lined cupola will extract phosphorus from molten iron and steel. But here is an illustration of the fact that in normal cupola practice, molten steel, containing a carbon pick-up from an acid-lined cupola furnace, will actually absorb the phosphorus from any slag with which it comes in contact in that furnace to an extent that will leave the phosphorus content at a point about six times that of the related slag, before the affinity of steel for phosphorus is lost. The carbon pick-up is mentioned here because of the possibility that the presence of carbon is necessary if the phenomenon is to function.

Rate of Phosphorus Pick-up

From several analyses of the steel product and slag, sufficient information has been gleaned to establish that the phosphorus content of the steel passing through the cupola and the percentage pick-up of the phosphorus after melting therein, appears to vary inversely as the weight of steel acting as a scavenger of the phosphorus throughout the scavenging period, until the percentage of phosphorus present is negligible. This, however, is not practicable as a means of eliminating phosphorus owing to the weight of steel involved.

These results can be plotted in the form of a graph if the percentages of phosphorus present in the steel melt are taken as the ordinates and the weight of steel passing through the cupola furnace as the abcissæ. At first, there will almost be a straight-line relationship between these factors which will eventually tail off into a flattened curve. This will be almost horizontal and show a percentage difference of phosphorus content which will not alter much as the process continues, as will be seen on the graph (Fig. 1).

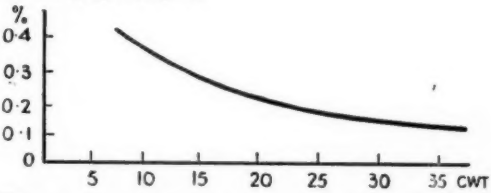


FIG. 1.—*Graph showing the absorption of phosphorus (per cent.) in steel in the acid-lined cupola.*

Though the point of entry of the phosphorus into the steel in the course of manufacture has thus been determined, no attempt will be made to get rid of the phosphorus by following the obvious course indicated by the experiments of passing a basic addition through the cupola, because of the well-known objections to such a course. Instead, a re-lined cupola was detailed for the exclusive melting of steel and difficulties encountered through the presence of phosphorus in the steel product were in this way overcome.

* The Author is attached to the Cross Foundry & Engineering Company, Limited.

News in Brief

THE INCOME LIMIT under which self-employed and non-employed people can apply to be excused from paying national insurance contributions is being raised from £104 a year to £156 a year from June 6.

THOMAS BROADBENT & SONS, LIMITED, engineers, Central Iron Works, Huddersfield, have bought from the Huddersfield Corporation the 100-year-old Model Lodging House, with adjoining property.

THE LOSS IN PRODUCTION in the Rhodesian copper mines as a result of the recent strike can now be estimated at about £11,000,000. The figure is arrived at by comparing the production for January and February with the December figure of approximately £9,500,000.

THE MEETING of the Foreign Ministers of the six countries in the European Coal and Steel Community, which began in Messina last week, has decided to nominate M. René Mayer as president of the High Authority of the community in succession to M. Jean Monnet.

WILLIAM DOXFORD & SONS, LIMITED, Sunderland, have despatched a ship's crankshaft weighing over 56 tons to a vessel at Marseilles, France. This is the fifth crankshaft shipped in this manner by the company to overseas firms who make Doxford engines under licence.

THE US TREASURY DEPARTMENT has begun an anti-dumping investigation into imports of cast-iron soil pipe from Britain. Custom Service field officers have been directed to withhold appraisals of such British shipments while there is an investigation of the question of whether British pipe is being sold in the US at less than fair value.

FOR TWO YEARS, Frank Wade, Limited, of Marlborough Foundry, Lye, Stourbridge, have been searching for a thin man for patching their cupola. The job is worth £10 a week, but the man has to be slim enough to clean furnaces of only 22 in. dia. Years ago such work was done by youths, usually apprentices, but there is nowadays a shortage of trainees.

BRITISH INSULATED CALLENDER'S CABLES, LIMITED, have brought into service a demonstration caravan which will tour the country with an exhibition showing in great detail the use of plastic compounds, such as P.V.C. and polythene, in the manufacture of all types of electric cables. The caravan will tour England, Scotland and Wales, travelling approximately 4,200 miles.

A RECORD TONNAGE of sinter was produced in the Apex and Seraphim plants of the Appleby-Frodingham Steel Company branch of the United Steel Companies, Limited, during the week ended May 21, with an output of 65,930 tons. The previous best, 62,490 tons, was achieved in February. In the same week last month the "Queen Bess" blast furnace had a record output of 6,220 tons.

ORMSBY BANK, near Middlesbrough, a stretch of the Whitby road used by many Tees-side steelworkers, in the North Riding, has been resurfaced with asphalt which has electric elements embedded in it to prevent icing in frosty weather. This is thought to be the first experiment of its kind in the country. The elements are connected to the public supply and build up heat during off-peak periods to maintain the surface temperature above freezing point.

POLYGRAM SHELL MOULD COMPANY (PTY.) LIMITED, of South Africa, an associate company of Polygram Casting Company Limited, London, now report that their percentage of licensees operating the shell-moulding process has increased to 8.6 per cent of the Union's foundries. While the proportion of shell-moulded castings in South Africa has not yet reached the maximum potential within the present limitations of the process, the output is increasing steadily.

DIEMAG civil engineering works, in Western Germany, has secured a contract valued at about £17,000,000 for a steelworks near Heluan, Egypt, with a capacity of 264,000 tons of crude steel, and a rolling mill for 200,000 tons per year. Work on the project has already begun. The company is to accept shares for 20 per cent. of the f.o.b. value of machinery and installations, and it is announced that the disposal of these shares within a few years after the plant has started production has been guaranteed.

NET PROFIT of the South African Iron & Steel Industrial Corporation, Limited, for the year ending June 30, 1954, amounted to £6,347,000, according to the corporation's annual report. Ingot production amounted to 1,237,000 tons, an increase of 66,000 tons on the figure for 1952-53. The total sales of rolled, drawn, and forged steel products increased by 64,000 tons to 919,400 tons, compared with the previous financial year. The total tonnage and value of all products sold during the year amounted to 1,093,000 tons, the net sales revenue being £34,344,000.

DEMAND by industry for graduates of the department continues to be far in excess of supply, states Prof. A. L. Roberts, Livesey Professor of the Department of Coal Gas Fuel Industries with Metallurgy at Leeds University, in his report on the department for the year 1953-54. Prof. Roberts says that at the end of the session 17 of the department's graduate and post-graduate students took up industrial or other appointments. In future years the number available for immediate employment is bound to be very much less, because of the two-year lag imposed by National Service obligations.

MAGNET HOUSE, Newhall Street, Birmingham, the new headquarters of the sales organization of the General Electric Company, Limited, in the Midlands, which was opened by the Lord Mayor of Birmingham (Alderman J. R. Balmer), occupies a square one-acre site at the intersection of Newhall Street and Charlotte Street and consists of two four-storey wings enclosing a single-storey storage area. The new premises will enable Mr. Norman Hill, the Midlands district sales manager, and his colleagues, to provide the area with showroom, stockroom, and service facilities worthy of the region's importance.

A CONTRACT worth more than £2,000,000 for the construction of a new coke-oven and by-product plant at Murton has been awarded to Woodall-Duckham Construction Company, Limited, by the Durham Divisional Coal Board. The board will shortly commence site clearance work and the project is scheduled for completion by September, 1958. The new plant will be an essential part of the board's scheme for a combined mine where coal from Murton and Eppleton collieries, and ultimately from Elemore Colliery, will be drawn up the new Hawthorn shaft now in process of sinking.

LAST WEDNESDAY, at the Midland Station Hotel, Belfast, a luncheon was held, under the chairmanship of Mr. Cyril Cohen, to celebrate the 75th anniversary of the foundation of the North of Ireland branch of George Cohen Sons & Company, Limited. The princi-

News in Brief

pal guests were Sir Frederick Rebbeck, D.SC. (chairman of Harland & Wolff, Limited); Sir Kenneth Sinclair, D.L. (chairman of the Belfast Harbour Board), and Lord Glentoran (Northern Ireland Minister of Finance). The origin of the establishment of the Belfast branch resulted from a conversation between the late Mr. Pirrie and one of the directors of what is now the 600 Group, Mr. Lewis Levy.

ANOTHER FLEET of ore-carrying ships to deal with the expected increase in iron-ore imports has been ordered from British shipyards—nine vessels each of 13,500 tons, and four each of 9,000 tons dw. Three of the larger vessels are to be built on the Clyde—two by the Blythswood Shipbuilding Company Limited, Glasgow, and one by Lithgows, Limited, Port Glasgow. Four of them are to be built on the Tyne—three by Smith's Dock Company, Limited, and one by Swan, Hunter, & Wigham Richardson, Limited. The six other vessels are to be built by three Sunderland firms—two each of 13,500 tons by Sir James Laing & Sons, Limited, three each of 9,000 tons by Wm. Pickersgill & Sons, Limited, and one of 9,000 tons by Short Bros., Limited.

MR. H. F. SPENCER, managing director of Richard Thomas & Baldwins, Limited, and chairman of the British Institute of Management, will be one of the chief speakers at the Institute of Industrial Administration's Summer School, at Wadham College, from July 23 to 30, the theme of which is "Management Practice." Dr. Harold Whitehead, chairman of the Institute, will open the proceedings and among other speakers will be Sir Harold West, managing director of Newton Chambers & Company, Limited; Mr. A. King, Department of Scientific and Industrial Research; Mr. W. F. Garnham, technical assistant to the works director, Ransomes Sims & Jefferies, Limited, and leader of the Anglo-American Council Productivity Team on Industrial Engineering; Mr. F. H. Perkins, education officer, I.C.I., Limited; Lt.-Col. L. Urwick, chairman, Urwick Orr & Partners, Limited; Mr. D. Caplan, Board of Trade; and Mr. L. E. Warner.

A WEST BROMWICH foundry was fined £29 3s. by the Wednesbury Stipendiary Magistrates' Court after admitting five breaches of the Factories Act. There were two charges of failing to fence machinery, one of failing to keep records of checks made to the dust-extraction ventilating plant, one of failing to keep a department in a clean condition, and one of failing to supply goggles to a woman driller. Mr. B. H. Wood, for the firm, told the magistrate, Mr. K. S. Wood, that goggles supplied to workers were put aside after issue. The firm, he submitted, had discharged its duty but the human element had crept in. None of the summonses constituted a flagrant breach of the Act, said Mr. Wood, and the reason the one department had not been whitewashed and cleaned, was that interior decoration was done during the annual holiday and the foreman of the shop in question had locked it up to prevent pilferage. Mr. H. Gurney, HM Inspector of Factories, said that a gearwheel in the sand mill was unguarded, and as it was at head height, an operator shovelling sand could easily touch the gear wheel with his head. On one drilling machine there were four spindles, only three of which were guarded. Each revolved at 300 revolutions a minute, which constituted a danger. Regarding the cleanliness of the premises, Mr. Gurney said that workers alleged that the department had not been whitewashed for about ten years, whereas the Factories Act stated that the operation should be carried out every fourteen months.

Company News

ALLEN WEST & COMPANY, LIMITED, electric control and switchgear manufacturers, of Brighton—An extraordinary meeting has been called for June 21 at Brighton for the purpose of considering changes in the articles of association relating to the signing of share certificates.

LONDON ALUMINIUM COMPANY, LIMITED—Col. C. A. B. Lindop, the chairman, says that plans have been made on the basis of increased activity in all sections of the business and if, as expected, subsidiary and associated companies reach a profit-earning basis within the year, he feels reasonably confident that a year hence conditions will be much more favourable.

PLATT BROS. & COMPANY (HOLDINGS), LIMITED—The investment of the company in its subsidiary, Textile Machinery Makers, Limited, has been revalued at par and the resultant surplus of £302,526 has been placed to investment reserve. The group's full accounts for 1954 disclose a trading balance from textile machine products of £2,732,664, against £2,613,746, plus investment income, etc., of £162,182 (£164,200), to make £2,894,846 (£2,777,946).

GEO. W. KING, LIMITED, mechanical handling engineers, etc., of Stevenage (Herts)—In order to bring the issued capital more into line with that employed in the business, the directors propose to make a 50 per cent. scrip issue in ordinary shares to holders registered on May 27 of the existing 680,000 5s. ordinary. Treasury consent has been received. The directors also recommend maintenance of the dividend at 12½ per cent. on the increased capital for the year 1954. This is an effective increase of 4½ per cent. over the 1953 payment. Subject to audit, profit, before tax, has risen from £73,871 to £128,684.

VULCAN FOUNDRY, LIMITED—According to the new chairman, Sir George Nelson, the company's future policy must be governed principally by the continuing expansion of the Diesel, Diesel-electric, and electric traction market, combined with the progressive displacement of the steam locomotive. It was intended that the company's resources should be concentrated almost entirely on these types. At the same time, the works of Robert Stephenson & Hawthorns, Limited, at Darlington and Newcastle-upon-Tyne would continue to be available for the production of steam locomotives, boilers, and spares.

BRITISH OXYGEN COMPANY, LIMITED—The need of the company for additional capital was emphasized by Mr. J. S. Hutchison, the chairman, at the annual meeting. The company had already spent over the past five years, he said, some £19,000,000 on factories, machines, and equipment, and it was likely that in this year expenses would advance to a higher rate. The rapid expansion of trading would also require additional working capital. Depreciation at over £2,000,000 a year and profit retentions with income-tax investment allowances this year totalling £1,250,000 would go a long way to meet requirements.

RANSOMES & RAPIER, LIMITED, engineers and iron-founders, of Ipswich—At an extra-ordinary meeting, to be held after the annual meeting to-morrow (Friday), approval will be sought to reconvert the 6 per cent. cumulative preference, 5 per cent. "B" cumulative preference, and the ordinary stock into shares. The respective amounts will then be, £15,000 in 10s. shares, £115,000 in £1 shares, and £502,000 in 10s. shares. The directors state that prices have now been advanced to cover increased costs. Year-end orders on books amounted to nearly a full year's output, and better deliveries have improved the flow, especially in export markets where competition is keen.

Personal

Mr. A. E. EDMOND, head of the general cargo section at Cardiff Docks for the past eight years, has retired after 52 years in the dock industry.

Sir WILFRED AYRE has been appointed chairman of the research board of the British Shipbuilding Research Association in succession to the late Sir Maurice Denny.

Mr. ARTHUR TANTRUM, of Sheffield, who with his wife has just celebrated his golden wedding anniversary, used the first electric melting furnace in Sheffield about 50 years ago.

AFTER 43 years' service with Marcus H. Hodges, & Sons (Engineers), Limited, Exeter, Mr. A. G. WEEKS has retired at the age of 70. Mr. Weeks has the fine record of never having been late for work.

Mr. F. B. WHITHOUSE, a partner in Gladstone, Wyllie & Company, engineers and mill stores merchants, of London, E.C.3, has been appointed a director of the Baltic Mercantile & Shipping Exchange, Limited.

Mr. E. J. HUNTER, who is a director of Swan, Hunter, & Wigham Richardson, Limited, and of the Wallsend Slipway & Engineering Company, Limited, has been appointed a part-time member of the North-Eastern Electricity Board.

THE NEW factory at Cottingham, Hull, of G. Waddington & Son, Limited, industrial glove manufacturers, will be under the charge of Mr. A. E. WHELDON, who has been with the company for 18 years and whose family has served the concern since its inception a century ago.

Mr. D. E. FOX has been inducted president of the South Wales branch of the Association of Mining Electrical and Mechanical Engineers. Mr. D. J. THOMAS, who has retired after eight years as honorary secretary of the association, has been succeeded by Mr. R. D. WILLIAMS.

Mr. P. JACKSON, manager of the research and development department of William Doxford, & Sons, Limited, Sunderland, has gone to the United States. He is to give a lecture at the Massachusetts Institute of Technology, Boston, on the supercharging of the Doxford engine and on combustion problems in large Diesel engines.

Sir WILLIAM VERDON SMITH, who has been chairman of the Bristol Aeroplane Company, Limited, for the past 27 years, announced at the annual general meeting of the company his intention to retire from the post. He will remain a member of the Board, and is succeeded in the chairmanship by his son, Sir REGINALD VERDON SMITH.

To mark his retirement after 40 years with the company, Mr. J. A. T. DICKINSON, works director of the Small Heath Group of the B.S.A. Company, Limited, was presented by his colleagues with a television set and a refrigerator. The presentation was made by Mr. JAMES LEEK, managing director of the group, in the presence of parent board directors Sir FRANK SMITH and Mr. J. E.. ROWE.

Mr. TOM LAWSON, outside engineer manager of the Neptune Engine Works, Walker-on-Tyne, of Swan, Hunter, & Wigham Richardson, Limited, has been appointed engineer superintendent for A. Lusi, Limited, shipbrokers, of London, E.C.3. Mr. Lawson, who has been 19 years at the Neptune Engine Works as leading draughtsman and outside manager, is taking up his new appointment early in July.

ROBERT Q. WILSON has been appointed United Kingdom representative for Battelle Memorial Institute, the well-known international industrial research organization. He will be in charge of the London office—Battelle Institute, Limited, 46, Bryanston Street, W.1, and will maintain liaison for British firms sponsoring research at Battelle laboratories in Columbus, Ohio; Geneva, Switzerland; and Frankfurt/Main, Germany.

Mr. SYDNEY BUTTERWORTH, who has retired at the age of 67, was the oldest indentured apprentice with Newton, Chambers & Company, Limited, Thorncliffe, near Sheffield. His indenture, dated October 25, 1904, includes an undertaking that he will not "gamble with cards or dice, or play at unlawful games or frequent taverns." A printed wage schedule on the reverse shows that he received 6s. weekly at 14, rising by 1s. each year to the age of 21, when he received 12s.

SAMUEL FOX & COMPANY, LIMITED announce that Mr. G. R. BOLSOVER (director and consulting metallurgist) will retire from the company's service on June 30. Consequently, Mr. R. D. POLLARD has been appointed to the board and becomes director and chief metallurgist as from July 1. Mr. O. INMAN retires from his position as director of developments on June 30. His services, however, are being retained as engineering consultant to the company and he will remain member of the Board.

Obituary

Mr. GEOFFREY FALK, a director of Falk, Stadelmann & Company, Limited, makers of lighting, heating, and cooking appliances, of London, E.C.1, died on May 24.

Mr. THOMAS MCGLASHAN, agricultural works manager for Ruston & Hornsby, Limited, Grantham, from 1927 to 1936, when he returned to the company's Lincoln works to become works manager at Boultham, has died at the age of 68.

Mr. ERNEST POWIS, formerly sales director of the Phosphor Bronze Company, Limited, until he retired three years ago after 50 years with the firm, has died in Birmingham at the age of 81. Mr. Powis had been largely responsible for building up the overseas trade of the Phosphor Bronze Company, Limited, a task which took him all over the world.

The death is announced of Mr. R. M. GILLIES, who was manager of the London office of G. & J. Weir, Limited, the Glasgow engineers, from 1919 until his retirement in 1947. Mr. Gillies, who was 79, served his apprenticeship with John Brown & Company, Limited, Clydebank. During the first world war he was called to the Admiralty by Sir Thomas Bell to take charge of the engineering department for all ships except the heavy fighting ships.

SIR LESLIE BOYCE

Sir Leslie Boyce, who died on May 30 at the age of 59, was the first citizen born of a British Dominion overseas, and remaining within the Empire, to be elected Lord Mayor of London. Sir Leslie, who was born at Taree, New South Wales, was educated at Sydney Grammar School and Balliol College, Oxford, and after reading for the Bar was called by the Inner Temple in 1922. He was Conservative MP for Gloucester from 1929 to 1945 and Lord Mayor of London in 1951.

Chairman and managing director of the Gloucester Railway Carriage & Wagon Company, Limited, Sir Leslie was also chairman of Gloucester Foundry, Limited, Wagon Repairs, Limited, Wm. Gardner & Sons (Gloucester), Limited, and other companies.

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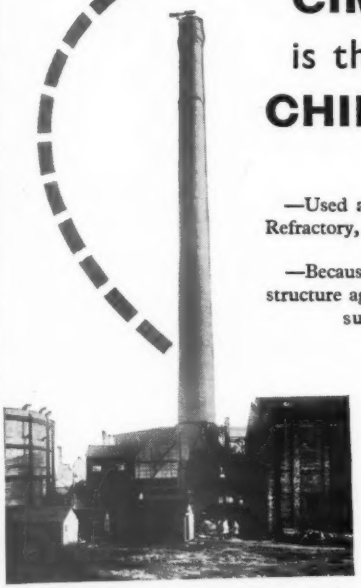
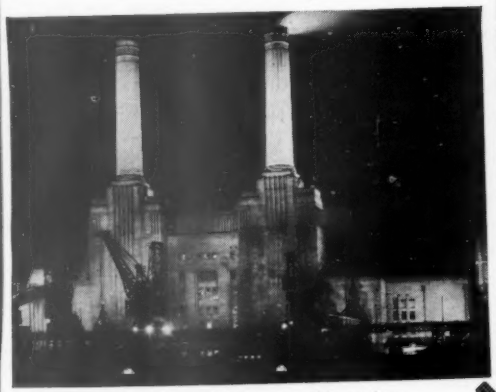


Wallasey Power Station. Ciment Fondu mortar was used for the jointing of the interior brickwork of this chimney.

Shell's Shellhaven Refinery, Essex. These 9ft. diameter steel stacks have been lined with Ciment Fondu insulating concrete.



Battersea Power Station where chimneys have been lined with Ciment Fondu mortar.

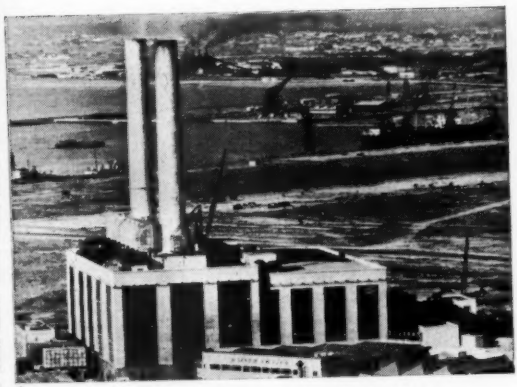


Table Bay Power Station, South Africa. Chimneys gunited with Ciment Fondu mortar.

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AP 6-1308

Raw Material Markets

Iron and Steel

With the extension of the rail strike into the second week a slowing down of iron and steel production was unavoidable. Few transport improvisations are of any use to the blast furnaces, whose outputs are almost wholly distributed by rail. Some pig-iron was moved by rail, but the foundries inevitably suffered. Because of the tight market position few of them held sizeable stocks.

Re-rollers were likewise the helpless victims of events. Normally they would be able to keep running for a time, but the rail strike found them with stocks of billets unusually low. The contingency is all the more deplorable since order-books have seldom been so full.

Much the same conditions prevail in the finished-steel trade, where the placing of new business has become impossible.

Foundries have to pay more for their coke and scrap as a result of the increase in railway freight charges from June 5. The Minister of Supply has made an Order increasing the controlled prices of scrap by amounts ranging from 6d. to 3s. 3d. per ton as from Wednesday.

Durham foundry coke for delivery in the Birmingham area is up by approximately 3s. 6d. a ton and Welsh foundry coke by 2s. 4d. Furnace coke for heating and core-oven purposes is also dearer, the price for Birmingham area deliveries having been advanced by 1s. 10d. a ton.

Non-ferrous Metals

Copper was again the centre of interest last week; the price moved up strongly, the settlement quotation last Friday being £349. This, however, gave place to a lower figure of £346 on the afternoon session, but the close was reasonably firm. There was more buying of cash last week, which accounted for the widening in the backwardation from £10 to £17.

This eagerness to secure prompt copper may well have been caused by purchases on account of consumers who found themselves with copper held up at the docks. There is a general expectation that with the settlement of the trouble at the docks the price will react to a lower level. On the whole, the demand for copper from the consumers is surprisingly good.

These are difficult days for the scrap-metal trade, but prices continue to be based on London Metal Exchange values. Copper wire scrap, both best quality and No. 1 copper wire, is rather cheaper in relation to the settlement price; this is probably due to the special RST quotation of £280, which is giving some users a supply of copper at nearly £70 below the LME quotation. So far there is no sign of any other producer following the RST lead.

On balance last week, copper gained £12 for cash and £8 for three months. Tin was up by 30s. for cash and 10s. three months, while zinc lost 10s. prompt and forward. Lead was steady and closed 5s. up for June and September.

Official metal prices were as follow:—

COPPER, Standard—*Cash:* June 2, £342 10s. to £345; June 3, £348 to £349; June 6, £348 to £349; June 7, £351 to £352; June 8, £350 10s. to £351 10s.

Three Months: June 2, £328 10s. to £329 10s.; June 3, £330 to £330 10s.; June 6, £328 to £330; June 7, £333 to £334; June 8, £333 to £334.

TIN, Standard—*Cash:* June 2, £717 to £718; June 3, £718 10s. to £719; June 6, £715 10s. to £716; June 7, £718 to £718 10s.; June 8, £720 to £720 10s.

Three Months: June 2, £717 10s. to £718; June 3, £718 10s. to £719; June 6, £716 10s. to £717; June 7, £719 to £719 10s.; June 8, £720 10s. to £721.

LEAD—*First half June:* June 2, £103 to £103 5s.; June 3, £103 to £103 5s.; June 6, £102 to £102 5s.; June 7, £102 15s. to £103; June 8, £103 to £103 5s.

First half September: June 2, £102 15s. to £103; June 3, £102 15s. to £103; June 6, £102 to £102 5s.; June 7, £102 15s. to £103; June 8, £103 to £103 5s.

ZINC—*First half June:* June 2, £91 5s. to £91 10s.; June 3, £90 10s. to £90 15s.; June 6, £88 15s. to £89 5s.; June 7, £90 5s. to £90 10s.; June 8, £91 5s. to £91 10s.

First half September: June 2, £89 5s. to £89 10s.; June 3, £88 15s. to £89; June 6, £87 5s. to £87 10s.; June 7, £88 15s. to £89 5s.; June 8, £89 10s. to £89 15s.

Latest Foundry Statistics

The Council of Ironfoundry Associations announces that employment in ironfoundries during the week ending April 2 was 144,740. The corresponding earlier figures were February 26, 1955, 144,733, and April 3, 1954, 140,496.

According to the British Bureau of Non-Ferrous Metal Statistics, world smelter production of copper (excluding secondary production) fell by approximately 9,000 tons in 1954 and totalled 2,706,400 long tons. This included an estimated production of 334,000 tons in the Soviet sphere compared with 331,500 in 1953. Production in the rest of the world totalled 2,372,449 tons compared with 2,384,235 tons in 1953. World production of slab zinc totalled 2,368,800 tons in 1954, an increase of 41,100 tons over 1953. This included an estimated production of 323,000 tons in the USSR, Poland and other Soviet-controlled territories.

Foundrymen Seek More Pay

An emergency resolution calling for a " a substantial increase in wages " to be paid from the date of application was passed by the conference of the Amalgamated Union of Foundry Workers at Hastings last week.

Mr. G. R. Garland (Glasgow) said that wage rates in the foundry industry were a national scandal.

On Wednesday, delegates unanimously approved a resolution calling for the renationalization of the iron and steel industry and the transport services without further compensation.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference ESB can be obtained from the Board of Trade, Export Services Branch, Lacon House, Theobalds Road, London, W.C.1 (telephone: CHAncery 4411, ext. 738 or 771), unless otherwise stated.

PAKISTAN, June 13—Cast-iron sluice valves, for the Department of Supply and Development, Government of Pakistan. (ESB/11115/55.)

GREECE, June 13—Centrifugal pumps and water meters, for the Ministry of Agriculture Reconstruction Procurement Committee. (ESB/11190/55.)

PORTUGUESE EAST AFRICA, June 15—Three centrifugal pumps and ancillary equipment, for the Permanent Purchasing Commission, Lourenço Marques. (ESB/11111/55.)

SOUTH AFRICA, June 16—Woodworking machines, for the Union Tender and Supplies Board. (ESB/11427/55.)

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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

June 8, 1955

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £15 12s. 0d.; Birmingham, £15 5s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £17 13s. 9d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £18 9s. 3d.

Scotch Iron.—No. 3 foundry, £18 2s. 3d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £20 4s. 0d.; South Zone, £20 6s. 6d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £21 1s. 6d.; South Zone, £21 4s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £18 2s. 6d.; Scotland (Scotch iron), £18 9s. 0d.; Sheffield, £19 7s. 6d.; Birmingham, £19 14s. 6d.; Wales (Welsh iron), £18 9s. 0d.

Basic Pig-iron.—£15 15s. 6d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots).—40/55 per cent., £40 15s. 0d., basis 45 per cent. Si, scale 15s. per unit; 70/84 per cent., £63 0s. 0d., basis 75 per cent. Si, scale 16s. per unit.

Ferro-vanadium.—50/60 per cent., 23s. 8d. to 25s. 0d. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 11s. 0d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £161 0s. 0d. to £165 0s. 0d. per ton; 38/40 per cent., £258 0s. 0d. to £262 0s. 0d. per ton.

Ferro-tungsten.—80/85 per cent., 17s. 2d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 20s. 2d. per lb. of W.

Ferro-chrome (6-10 ton lots).—4/6 per cent. C, £83 0s. 0d. to £86 0s. 0d., basis 60 per cent. Cr, scale 25s. 0d. per unit; over 6 per cent. C, £81 0s. 0d. to £84 0s. 0d., basis 60 per cent. Cr, scale 24s. 0d. per unit; 2 per cent. C,* 1s. 10¾d. per lb. Cr; 1 per cent. C,* 1s. 11½d. per lb. Cr; 0.15 per cent. C,* 1s. 11d. to 2s. 1d. per lb. Cr; 0.10 per cent. C,* 1s. 11d. to 2s. 2d. per lb. Cr; 0.06 per cent. C,* 2s. 3d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 6s. 10d. to 7s. 4d. per lb.

Metallic Manganese.—93/95 per cent., carbon-free, £225 0s. 0d. to £232 0s. 0d. per ton; 96/98 per cent., £259 0s. 0d. to £265 0s. 0d. per ton.

Ferro-columbium.—60/75 per cent., Nb + Ta, 52s. 6d. to 70s. 0d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £53 17s. 6d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £25 5s. 0d.; tested, 0.08 to 0.25 per cent. C, £26 5s. 0d.; hard (0.41 to 0.60 per cent. C), £27 10s. 0d.; silico-manganese, £34 10s. 0d.; free-cutting, £29 6s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £32 17s. 0d.; silico-manganese, £34 10s. 0d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £29 13s. 6d.; basic, hard, over 0.41 up to 0.60 per cent., C, £30 16s. 0d.; acid, up to 0.25 per cent. C, £33 15s. 0d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £31 1s. 6d.; boiler plates (N.-E. Coast), £33 11s. 6d.; floor plates (N.-E. Coast), £32 10s. 0d.; sectional material, N.-E. Coast, £29 4s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £31 19s. 6d.; flats, 5 in. wide and under, £31 19s. 6d.; hoop and strip, £33 1s. 6d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £34 5s. 0d.; black sheets (hand mill), 17/20 g., £43 13s. 6d.; galvanized corrugated sheets, 24 g., £55 4s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £54 7s. 9d.; nickel-chrome, £76 7s. 9d.; nickel-chrome-molybdenum, £86 8s. 6d.

NON-FERROUS METALS

Copper.—Cash, £350 10s. 0d. to £351 10s. 0d.; three months, £333 0s. 0d. to £334 0s. 0d.; settlement, £351 10s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 3s. 3½d. per lb.; rods, 389s. 9d. per cwt. basis; 20 s.w.g., 423s. 0d. per cwt.

Tin.—Cash, £720 0s. 0d. to £720 10s. 0d.; three months, £720 10s. 0d. to £721 0s. 0d.; settlement, £720 10s. 0d.

Lead (Refined Pig).—First half June, £103 0s. 0d. to £103 5s. 0d.; first half September, £103 0s. 0d. to £103 5s. 0d.

Zinc.—First half June, £91 5s. 0d. to £91 10s. 0d.; first half September, £89 10s. 0d. to £89 15s. 0d.

Zinc Sheets, etc.—Sheets, 15 g. and thicker, all English destinations, £121 15s. 0d.; rolled zinc (boiler plates), all English destinations, £119 0s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £103 0s. 0d.

Brass Tubes, etc.—Solid-drawn tubes, 2s. 7⅝d. per lb.; rods, drawn, 3s. 5½d.; sheets to 10 w.g., 338s. 6d. per cwt.; wire, 3s. 2¾d.; rolled metal, 324s. 3d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £211; B6 (85/15), —; BS249, £224.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £270; HTB2 (38 tons), £278; HTB3 (48 tons), £284.

Gunmetal.—RCH, 3/4 per cent. tin, —; BS1400, LG2 (85/5/5/5), £295; LG3 (86/7/5/2), £302; G1 (88/10/2/½), £371; (88/10/2/1), £356.

Phosphor Bronze.—BS1400, PB1 (AID released), £382 per ton.

Phosphor Bronze Strip, etc.—Strip, 471s. 3d. per cwt.; sheets to 10 w.g., 494s. 9d. per cwt.; wire, 4s. 10½d. per lb.; rods, 4s. 2¾d.; tubes, 4s. 1d.; chill cast bars: solids 4s. 4d., cored 4s. 5d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 4s. 0½d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 5¾d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 4s. 4¾d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 3d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £108 0s. 0d. Nickel, £519 0s. 0d. Aluminium, ingots, £163 0s. 0d.; aluminium bronze (BS1400), AB1, £341; AB2, £349. Solder, brazing, BS1845, 2s. 10d. lb.; granulated, 3s. 2d. lb.

* Average 68-70 per cent.